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IN THIS ISSUE

THE Round Table on "New Steps in Public Health" which was a part of the Fund's Twenty-second Annual Conference was concerned with current problems of public health and methods of solving them. Four papers appeared in the October *Quarterly* illustrating the needs of various groups in the community for relief from illness and disability and for disease prevention and health promotion. These served as a background for the discussion. The papers concerned with suggested solutions of these public health problems are published in this issue.

On the second day of the Annual Conference, the group engaged in discussing "New Steps in Public Health" met with the Food and Nutrition Board of the National Research Council. The six papers in this issue dealing with nutrition in public health were presented at this combined meeting.

The paper by Dr. Jean Alonzo Curran, who served as chairman of the Round Table, reviews the development of medical care facilities in this country and the progress of thought in regard to medical care. Dr. Curran points out some of the weaknesses and deficiencies in the present system and discusses some of the experiments in group practice. He sees the need for more comprehensive planning based on the concept of the patient in relation to his total environment. He recommends a broader and more integrated plan for the education of medical personnel, improved organization, closer cooperation with ancillary workers, and general education so that the public will support and participate in plans to keep health at a maximum level.

In the paper, "Proper Attention to the Role of Emotional and Social Factors in Illness as a New Step in Public Health," Dr. G. Canby Robinson states that emotional and social problems influence the condition of a large proportion of patients and that frequently they are the major cause of illness. Studies of patients admitted to outpatient departments

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indicate that 65 per cent of the patients are faced with adverse social conditions which are directly related to their illness. These adverse conditions are the major precipitating cause of illness in 36 per cent of the patients and cause emotional disturbances in over 50 per cent of the patients. Dr. Robinson believes that proper attention to the emotional and social factors involved in illness is of value not only in clinical medicine in the treatment of a particular patient, but also has wide implications and significance for public health and preventive medicine.

New concepts in public health make necessary additional community facilities and more efficient use and better integration of the existing facilities. Mr. Bailey B. Burritt discusses some of the newer concepts and their implications in "More Adequate Provision and Better Integration of the Community Facilities." Of primary importance is the concept of the maintenance of health, rather than the treatment of disease, as an objective. To maintain health, periodic health inventories are needed to determine early departures of individuals from healthy conditions. The concept of the relation of the individual personality to disease and the basic concept of the individual as an integral part of the family make new demands upon the present community services and public health programs. Health education requires more careful and effective plans, new techniques, and more adequate facilities for teaching health. Mr. Burritt emphasizes the importance of integrating the present health services and adapting them to suit the newer concepts as well as developing new facilities.

In the paper, "The Role of Nutrition in Preventive Medicine," Dr. F. F. Tisdall has assembled evidence which shows that diets not adequate in all respects, but not producing well-marked classical deficiency syndromes may impair the health and efficiency of the individual throughout life. Because of their infrequent occurrence the so-called nutritional deficiency diseases, such as scurvy, pellagra and beri-beri, do not constitute important public health problems. Dr. Tisdall believes that, "There is no one factor which so affects the health of the people as the food they eat." The data presented in this paper should be of value to the administrator in planning a well-rounded program for the improvement of individual health and, therefore, of the public health.

The relation of nutrition during pregnancy to the condition of the child and also of the mother is discussed by Bertha S. Burke in "Nutrition—Its Place in Our Prenatal Care Programs." Long-continued studies

revealed that the general dietary rating of the mother during pregnancy was directly related to the condition of the infant at birth and within the first two weeks of life. A significant relationship was also found between the protein content of the mother's diet during pregnancy and the length and weight of the infant at birth. The course of pregnancy varied significantly with the dietary rating of the mother although to a lesser extent than did the condition of the infant. The diet of the mother during pregnancy also appeared to influence the incidence of toxemia and the average length of labor of all the primiparae. The author concludes that great gains in national health might be brought about by effective and intelligent nutrition teaching during the prenatal period.

It has been commonly believed that anatomical abnormalities present at birth are due to genetic influences. In the paper, "The Importance of Prenatal Diet," Dr. Josef Warkany presents a summary of the results of animal experiments which have shown that maternal nutritional deficiency is directly related to certain anatomical abnormalities of the offspring. The experiments were carefully controlled in order to determine the exact cause of particular abnormalities. The specific deficiencies which produced anatomical abnormalities of the offspring were riboflavin and vitamin D. Lack of riboflavin in the maternal diet produced a proportion of offspring with abnormalities such as syndactylism, brachydactylism, and cleft palate. Vitamin D deficiency was found to manifest itself in the fetus in a different way than in the infantile rat; it produced a peculiar abnormality of the ribs in which the osteoid was missing or not abundant. Dr. Warkany concluded that the science of nutrition should be concerned not only with the maintenance of the human machine but should also pay attention to its sound construction.

To maintain the highest efficiency in production in wartime, it is proper to consider the industrial workers' nutritional problems. In the paper "Protecting the Health of the Industrial Worker: Nutrition," Dr. Robert S. Goodhart reviews the organization and accomplishments of the government's industrial feeding program and indicates the major problems which remain to be solved. A clear presentation to industrial management of the relationship between nutrition and health, morale, fatigue, industrial diseases, and accidents is stated as one of the most urgent needs. This is considered the responsibility of the industrial physician who should also take an active supervisory role in the industrial food service.

Even though the proportion of the population now engaged in hard physical work is small, the effect of energy expenditure of various degrees upon nutritional requirements is a matter of more than academic interest. In the paper, "The Effects of Hard Physical Work Upon Nutritional Requirements," Dr. W. H. Forbes surveys the present status of knowledge in this particular field. He describes work of various degrees, light, moderate, and hard, in terms of their effect upon man's basal state. Dr. Forbes believes that the general indications from experimental studies are that light or moderate, or even hard physical work adds only to the caloric requirements and increases the needs for proteins and certain of the vitamins little, if at all. He noted also that nothing is known of the extra requirements, if any, for the kind of work that the average industrial worker performs, namely, work which is physically easy but nervously or emotionally tiring.

To reduce the hazard to the worker of occupational poisons there are two methods of approach, both of which are important. One is to reduce the risks through proper ventilation for removing such materials as dust, fumes, and vapors. The other method is to give attention to the resistance of the worker to toxic exposures in which nutrition appears to be a major concern. In the paper, "The Improvement in Nutrition as a Protection Against Industrial Toxicity," Dr. W. E. Crutchfield, Jr. reviews the present state of knowledge concerning the effects of specific types of poisonings upon human nutrition, and the effects of improved nutrition upon resistance to poisonings. Research in this field is still in its infancy, and in the future is likely to achieve a status of great importance.

PROVISION OF BETTER MEDICAL CARE

JEAN ALONZO CURRAN, M.D.[1]

THE provision of better medical care for the country would seem to require a platform resting on four pillars: (1) A broader concept of community planning for the care of the whole patient in his entire environment. (2) A more comprehensive and better integrated plan for the education of good doctors and associated personnel. (3) Much improved organization and team work of workers already available. (4) Education of the general population to cooperate, support, and actively participate in arrangements being worked out for the advancement of health and the reduction of disease.

Taking up these points in order, one cannot help but be impressed with how institutionally minded we have been in most of our thinking and our acting. When Benjamin Franklin and his associates built our first haven for the sick, the Pennsylvania Hospital, in 1750, the prospectus they prepared clearly indicated their belief that they had found the final answer for the care of the sick poor, both physical and mental.

In the two hundred years extending from Franklin to Goldwater, we seem to have been obsessed with the idea that if we can only build enough hospitals and put enough patients to bed in them, disease will be conquered and a healthy and a happier population will result.

Most of this hospital construction has been completed during the past fifty years. In 1870, with a population of approximately 50 million, there were about 50,000 beds while today, with a population of approximately 135 million, we have 1,200,000 beds, revealing the tremendous increase during that period.

Perhaps historians will agree that this period might be called the Johns Hopkins Era, for that group of young enthusiasts gathered

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together by Gilman and Billings in the 1880's dramatized the idea that the application of scientific methods in a highly-organized hospital environment might be the final answer in the age-long search for the fountain of health.

The new discoveries in bacteriology and biochemistry made the hospital and the affiliated research laboratories seem the ideal focus for a new attack upon these problems created by disease. The wonderful advances in surgery during this half-century have been made possible only through hospitalization.

The concentration of patients in these great centers of healing brought about the evolution of the clinical clerkship, the specialized internship and residency, and the highly-developed services in our leading hospitals, of which we can be so justly proud.

Yet as early as 1897, Osler was conscious of a missing ingredient in the new health recipe. In spite of his best efforts, three-quarters of his clinic patients did not really get well but returned again and again with the same old complaints. His attempts to grapple with these additional complications in the patient's life outside of the hospital eventually resulted in Emerson's, Pratt's, and Cabot's interest in environmental medicine and the appearance on the scene of the medical social service worker.

Despite these leads, the energies of the medical profession have been increasingly absorbed by the rapidly-expanding demands of their hospital duties. Their contact with home conditions has been confined to private patients, who now comprise a minor portion of the population. The disappearance of preceptorships has closed the door to this possibility for the introduction of the student to the art of practice and acquaintance with the way of life of the average patient.

Curiously, the phenomenal growth of hospitalization seems to leave us at present as far behind as ever in meeting anticipated requirements. Approximately half of all hospital beds are occupied by psychopaths, most of them receiving—at least in the past—little

more than custodial care. Yet hospital construction for the insane lags several thousand beds behind the anticipated demand. There has been a shortage of beds also for tuberculars, even though there has been a marked drop in mortality from this cause.

Along with this lag of hospital construction, there are other serious defects in the hospital program. The naive concept on the part of the public that all that is required is to get the patient into a hospital bed has been responsible for woefully inadequate provision or at least financial provision, for laboratory space and personnel. A large laboratory building completed some ten years ago, to serve one of our largest hospitals, was converted because of public clamor into a tuberculosis unit, which it still is.

Laboratory personnel under Civil Service are so underpaid that adequate service is seldom possible except where supplemented by medical school assistance. While the present city administration is keenly alive to these deficiencies and anxious to correct them, it is doubtful if remedies can be applied until the end of the war.

The wave of standardization which has necessarily accompanied these vast developments for housing the sick has depersonalized much of the medical attention given. A fetish has been made of a pattern involving a sequence of a routine history, routine physical examination, routine urinalysis—often very carelessly done—routine blood count, routine blood-chemistry, and routine treatment, as though there were something magical in the process.

A review of the records of ward patients in fully half of our hospitals brings one to the depressing realization that much of the process is wasteful of time and of materials and that little thought and discrimination has been given to individualization of the patients' needs. Most of this routine work-load and the accompanying paper work has been delegated to the interns, who after a period of initial disillusionment, carry out these assignments because they must, with the hope of eventual reward in the shape of opportunities to perform major surgery. They realize that a great deal of this

effort is simply going through the motions to satisfy the inspections of the American Medical Association and the American College of Surgeons.

I should like to suggest that a fertile field for research would be a critical evaluation of all of these and other routine hospital procedures. While a great deal of wastage and misapplication of time and effort would be uncovered, a rare opportunity would be presented to discerning educators and hospital leaders to evolve better approaches to diagnosis and to understanding of patients' needs.

This overemphasis on the value of standardized hospitalization has encouraged in medical faculties, students and interns, a myopic tendency to consider the hospitalization episodes as all-revealing and all-important.

Yet the average, hastily recorded history in a non-teaching hospital at least is practically valueless in giving a young doctor-in-the-making a picture of the patient's background. His inability to visualize the patient in his natural setting inhibits the development of any genuine interest or understanding of him as a person, and the hospital stay is devoted largely to a sort of guessing game of differential diagnosis. Interest tends to be lost as soon as a label is applied to the disease, and the intern's chief concern is then to clear the bed for another diagnostic exercise. Most medical students and interns, if they are frank, will admit that in their eyes, a good internship is one that presents as rapid a succession of such cases as possible. Little or no interest is evidenced in what happens after discharge to the out-patient department or to the home.

The seriousness of this lack of interest is revealed by the study just published by Jenson, Weiskotten, and Thomas. Their book, MEDICAL CARE OF THE DISCHARGED PATIENT, it seems to me is really an epoch-making publication. It is frankly startling to learn that approximately 90 per cent of the patients cared for on the general medical services of a university hospital were suffering from acute episodes complicating chronic illness and that only one-third of them re-

ceived adequate medical attention on return to their homes, unless it was supplied by an extramural, salaried resident.

With this additional assistance, it was possible to give consideration to the patient as a person, to consider him in the light of both psychic and somatic factors, and to make a social study of his resources and home environment.

It should be pointed out that other experiments with extramural residency service have been in existence for some years in connection with, for example, Tufts Medical School and the Boston Dispensary and with Buffalo University and the Edward J. Meyer Memorial Hospital in Buffalo. In the former instance, medical students care for patients in the homes under a resident's guidance. That plan is still in operation, in spite of war shortages.

Some years ago I had the privilege of seeing at first hand the personal guidance given by Dr. Robinson to home environmental studies made by Johns Hopkins students, which culminated in his book, THE PATIENT AS A PERSON.

Mention should also be made of arrangements in Vermont and Wisconsin, where because of limited hospital facilities, medical students are assigned to preceptors in general practice.

Other medical schools have introduced teaching exercises in domiciliary medicine but not as a part of an organized plan of medical service. Unless such a formal plan can be put into effect, the impression made on the student cannot be very convincing and he is liable to look upon it merely as an interesting and perhaps baffling play exercise.

One cannot help but be deeply impressed with the possibilities revealed by the Boston, the Buffalo, and the Syracuse projects. Through the employment of residents who spend approximately half of their time following patients into their homes, two birds are not killed but cured with one stone. Patients who ordinarily would receive inadequate attention are properly cared for, and the young doctor receives an introduction to the world of medicine under

circumstances identical with those he will encounter when he enters practice.

As medical students, interns, and residents participate in this broadened concept of medical responsibility and plans for its implementation, the door is opened at last for escape from the confining walls of hospitalization which have hemmed in medical education for the past half-century. Instead of facing the danger of a period of depressing and deteriorating inactivity when the resident begins independent practice, for example, the newly-launched physician will be able to forge ahead under full steam.

The extramural resident has a sense of personal responsibility for following his patients and they look to him as their family doctor. He gives a continuity of service and enjoys the stimulus of a teaching program as he supervises medical clerks assigned to work under his direction.

To give you a contrast, the system formerly in vogue here in New York City of rendering service to the same type of people by interns riding ambulances was hurried, inadequate in quality and lacking in continuity, and there was no opportunity for acquiring a sense of personal responsibility and interest. While there was educational value of a sort—chiefly in making snap diagnoses—it was largely unorganized and unsupervised.

An interesting sidelight, I think, is the matter of financing.

The extramural residency plans, as I investigated them some years ago in Boston, cost approximately $1.50 a house call, compared to, if I remember correctly, approximately twice that much for each time an ambulance went out to make a call in New York City, although the interns were fond of pointing out that they worked for nothing or at most received fifteen dollars a month!

Although war scarcity has taken interns off our ambulances, an even greater scarcity of residents prevents consideration of the introduction of extramural residency systems at the present time. At the conclusion of hostilities, however, there will be an ideal opportunity

to introduce it and at the same time give returning Army and Navy medical officers very valuable graduate training.

Even in our leading teaching hospitals with highly-organized auxiliary nursing and social services where attention to patients on the wards and private pavilions is of a high order of excellence, studies have revealed faulty coordination in follow-up and loss of contact with general-service patients following their discharge. Even at Johns Hopkins Hospital, where Osler pioneered in the study of home conditions of his clinic patients and where recently Dr. Robinson furthered such studies with the assistance of a skilled social service worker, it is my impression that interest in these projects was greatly diminished after these leaders left Baltimore.

Hence it would seem obvious that a more fundamental hook-up must be achieved between our great hospitals and associated teaching centers and the communities they aim to serve.

Curiously, the current wartime prosperity with the shift of large numbers of ward and dispensary patients to private and semi-private status, would seem to be a step in this direction, although it bears no relationship to educational needs. Actually, the depletion of our wards and out-patient departments has detracted seriously from the teaching value to both students and interns.

Even if we assume that the condition is temporary and will revert at the conclusion of the war boom, other trends having ominous implications for medical education are on the horizon. Pre-payment plans, government subsidies, and insistence on the part of organized medicine on the free choice of physician, have already made serious inroads into our general hospital services which have been our main reliance as a base for organized teaching.

The profession and the public alike must be made to realize that superior medical care in the home, as well as in the hospital, can only be attained through cooperative group arrangements. It behooves medical schools to study carefully these possibilities, so education may continue its role of active leadership and participation.

During a recent tour of the country, I explored a series of such developments as an effort at my own self-education as to what we might expect in the Brooklyn area and the relationship our teaching hospitals will have thereto. Among centers visited was the great Pittsburgh-like industries in Birmingham, Alabama, where successful, comprehensive prepaid medical plans for workers and their families have been in operation for a number of years by the Tennessee Coal, Iron and Railroad Company and by the American Cast Iron Pipe Company. Also, the Roos-Loos Medical Group and the Douglas Aircraft health service in Los Angeles; the Permanente Hospitals in Richmond, California, and in Vancouver, Washington; and the plan at Van Port City, near Portland, Oregon; the health service system for city employees of San Francisco; the Southern Pacific Railroad Hospital; California Physicians Service; National Hospital Association; and the Michigan Physicians Service were inspected and a great deal of valuable data collected.

I was impressed that each situation was different from the rest. No one plan can be put forward as the final answer—even Kaiser's highly-publicized challenge to the doctors. His popular slogan that half the price of a package of cigarettes a day, seven cents, or a movie a week, fifty cents, will cover all the health needs of the employee, including 111 days of hospitalization, must be evaluated in the light of the peculiar conditions encountered. Many of the workmen are living in emergency housing, isolated from established hospitals and physicians. The workers are earning war boom wages and the voluntary deductions, to which 90 per cent subscribe, are supplemented by compensation insurance. By an arrangement with the carrier, Dr. Garfield receives 17.5 per cent of all premiums for compensation insurance. At Permanente, roughly one million of a two-and-a-half-million-dollar budget comes from this source.

The Permanente hospitals are models of ingenuity, and I was satisfied that at Richmond, especially, basic medical work was well done.

Much of the program is still in the course of development and a great deal of needed new construction is under way.

While home visits are included in the plan, one gained the impression that a large share of the full-time staff's attention was devoted to the in and out-patient case load. They work on regular eight-hour shifts, like all other employees. The ratio of doctors to patients is approximately one to 1,000 for total employees and dependents, but it is one to 3,000 if the eight-hour shifts are considered.

Dr. Garfield was keenly aware of the need of educational affiliations and was seeking these with the West Coast schools.

In general, one was impressed that a comprehensive medical coverage with a closed panel system can be worked out at a cost of somewhere between $25 and $35 a year per individual. Family coverage is much more difficult to estimate. At North Permanente, it adds up to a little more than $62 for the average family unit of four persons. Up there, because of the Portland situation, the average is 60 cents per individual per month for the workers, 30 cents for the wife, 15 cents for each child under sixteen years of age.

The open-panel plans on a fee-for-service basis are more difficult to administer to prevent abuses and usually end up by deducting such items as obstetrics and tonsillectomies in addition to such other usual exceptions, as mental disease and alcoholism.

Wherever I went I was impressed with how much excitement has been stirred up by the Murray-Wagner-Dingell Social Security Bill, and I could not help but conclude that it has provoked such tremendous discussion and controversy that even if it never comes out of committee, it will have the effect of setting in motion many constructive changes in our planning, from which a great deal of good will come.

Here in New York City we may expect a series of plans to be tried, including a merger of the Associated Hospital Service, Group Health Cooperative, the Elliott Plan, and a variety of other possibilities.

The Consolidated Edison Plan has been in successful operation for over a decade. Some of the other big industries are giving thought to the possibility of following Kaiser's example.

The great need is for a grouping of the large number of factories with fifty employees or less, where medical attention is poorest.

The need of educational leadership in these movements and the great stake medical education has in all of these eventualities at the undergraduate, the intern, the graduate, and the postgraduate levels, make it imperative that we work closely with each step of the process.

In rural areas the problem does not seem so complicated. Doubtless, all of you are familiar with experiments in rural hospitalization being carried out by The Commonwealth Fund in fourteen areas throughout the United States. Those of us who heard Dr. Lester Evans recently describe, before the Committee on Medicine and the Changing Social Order of the Academy of Medicine, the evolution of a sample hospital over a sixteen-year period were impressed with the positive influence there is for cooperation among the doctors replacing the intensive competition previously existing and encouragement for educational advancement through the development of special skills and associated use of laboratory facilities.

At present I am fortunate to have the opportunity to act as consultant to the Bingham Associates in studying two centers in Maine. One, comprised of fourteen hospitals, is grouped around the Central Maine General Hospital at Lewiston and the other, with a dozen satellites, is centered around the Eastern Maine General Hospital at Bangor.

Through Bingham subsidies, these hospital groups have been stimulated to work together in the utilization of such services as x-ray, pathology, electrocardiography, preparation of blood plasma, and in conducting clinical, pathological, radiological, and consultation conferences. Postgraduate courses, also subsidized by the BAF, for practicing physicians and for technicians have been provided at

the New England Medical Center in Boston, under Tufts Medical School auspices. Difficult cases may be sent to Boston for special diagnostic studies at a fixed minimum fee and then returned to the family doctor for treatment. The announced objective is to provide all the resources of modern medicine to the small rural community.

Other group practice developments worth watching are those at St. Johnsbury in Vermont and at Hanover in New Hampshire. In these areas the doctors work together as a group and fees collected are pooled and paid out pro rata on a salary basis—on the basis, I believe, of 90 per cent of their previous earnings. A reserve is maintained to pay for postgraduate courses and attendance at medical conventions to encourage investigation and presentation of papers. A member of the group may obtain these advantages without loss of income or fear that his patients will be weaned away from him during his absence. Also, consultations are freely available and an adequate corps of specialists is developed.

Although the emphasis so far among these rural plans has been on postgraduate teaching, there is a great deal of possibility for the education of both students and interns awaiting exploration. Cooperative internships and residencies might be worked out between the smaller hospitals and students might be brought into direct contact with community medicine, especially during peacetime summer vacations.

The need for a wide application of such patterns to rural areas may be illustrated by the contrast between New York City and the rest of the country. With only about 5 per cent of the population living in the metropolitan area, we have nearly 20 per cent of all the interns in the United States. Before the war about 90 per cent of them tried to set up practices in this region, favoring the overconcentration of physicians hereabouts. An obvious approach to a better distribution of doctors would be the education of students, interns, and residents through the introduction of hospital groups among whom they will find their life work.

If this trend should eventuate, the task of the federal, state, and city public health services would be made much easier and the opportunities for young physicians to work more closely together in both public and private health practice would be immensely enhanced.

The demands upon American medical education are steadily growing, in spite of wartime shortages, accelerated schedules, and now even threats to curtail the number of students. Besides our task of preparing doctors to care for our civilian population and our armed forces, there will undoubtedly be a growing and a tremendous demand for medical personnel and service among the countries devastated by the war. As chairman of the Committee on Education of the American Bureau for Medical Aid to China, I have been shocked to learn that all of the medical schools in that country produce less than one-tenth as many graduates as the annual crop in the United States—for a population over three times as large. And figures for India would be very nearly comparable.

In the mail this week, an appeal has gone out for older American physicians to go to China under the auspices of the War Department and the Chinese Government to meet this desperate need in Free China.

Hence, planning for better care in the United States must take into consideration the immense implications of the international situation.

Finally, a word or two should be said for the better support of schools of dentistry, nursing, social service, and physical and occupational therapy, which occupy positions akin to step-children in the medical family. Although medical schools have manifold deficiencies in financing and equipment, they are far in advance of these associated projects. The surface of preventive dentistry seems as yet barely scratched. Nursing and social service need much closer coordination and understanding in their educational strivings for professional standing. Unwillingness of physicians to give serious

study to physical therapy has borne fruit in the rapid, recent increase in the inroads of cults all over the country. The Baruch survey now in progress is an encouraging evidence of belated realism in facing this neglected field.

In conclusion, one must remember that all of this planning for better-educated doctors and for better distribution, organization, and support of their efforts will not reach its final objective if we do not go beyond the cure, palliation, or prevention of disease. In a world with vigorous, hardy peoples with high birth rates, such as the Russians, Germans, and Japanese, who may in the long run even challenge the survival of our race, we must strive for maximum health and physical efficiency. Toward this goal we must mobilize every resource we possess and think less in terms of bedside care of the sick and more in terms of fireside attention to the person in his home and in his surroundings, to keep his store and reserve of good health at its maximum.

PROPER ATTENTION TO THE ROLE OF EMOTIONAL AND SOCIAL FACTORS IN ILLNESS AS A NEW STEP IN PUBLIC HEALTH[1]

G. Canby Robinson, M.D.[2]

CONSIDERATION of this subject must be prefaced by a brief description of an effort to give proper attention to the emotional and social factors of illness as they are encountered in the out-patient department and wards of a medical service of a general hospital. Hundreds of patients have been studied from this point of view. Most of them have been studied without selection beyond their admission to the general medical service or to certain special clinics, and without previous knowledge of their emotional and social status.

Our study of the patients was begun after their physical status had been determined by the usual clinical methods that led to a diagnosis of organic disease or functional disturbance upon which a plan of treatment was usually based. The first step in the study of emotional and social problems was an interview which gave the patient an opportunity to relate what was on his mind in relation to his illness and which led him to give an account of his social situation, his mode of living, his habits, work, recreation, or anything else that seemed to throw light on the patient as a person, and to reveal evidence of what we have called "personality disorders." By this means information was obtained regarding emotional tension in the home or at work, sexual problems, moods, worries, anxieties, or frustrations. Evasions or subjects about which the patient did not want to talk were also noted. In most cases several interviews were held, and many patients were visited in their homes, where members of their families were seen and questioned. Any other information such as

[1] Reprinted from *Bulletin of the Johns Hopkins Hospital*, April, 1944, LXXIV, No. 4, pp. 259-265.

[2] From the Department of Preventive Medicine, Johns Hopkins University, School of Medicine.

reports from social agencies, the opinion of clergymen, teachers, outside doctors, or friends was obtained when practical in order to make our study of the patient as complete as possible.

All data on each patient was recorded by dictation, studied and later reviewed and discussed with the patient, in an effort to give proper attention to emotional and social factors as a basis for a plan of treatment correlated with that which had already been prescribed. These studies indicate that about 65 per cent of the patients admitted to the out-patient medical service are confronted with adverse social conditions that are directly related to their illness. These adverse social conditions cause emotional disturbances in over 50 per cent of the patients, and are the major precipitating cause of illness in about 36 per cent of the patients.

The first conviction that developed from these studies was that emotional and social problems disturb the health of a large proportion of the patients admitted to the medical service, most of whom are people of normal or average mentality, that these disturbances are often present in patients with organic disease, where they are especially likely to be overlooked, and that they frequently constitute the major cause of illness.

The second conviction was that giving proper attention to emotional and social factors of illness not only is a means of revealing the total individual and the various factors disturbing his health, but also brings to light problems of treatment that are essential to the restoration of health. It was obvious, therefore, that the study of the personal problems of the patient is a field of medical practice that deserves greater cultivation than it has had in the past, and is a component of medicine of paramount importance in medical education.

This conviction that consideration of the patient as a total individual is necessary in good medical practice has gained much ground recently, or perhaps we should say has *re*gained much ground. This conception is beginning to find its place in university hospitals and

in the curricula of medical schools, as well as being cultivated as a field of research.

If we now assume that the proper attention to the emotional and social factors of illness is of value in clinical medicine, let us give consideration to its value in the promotion of public health and preventive medicine. The study of the patient as a person as I have described it, directs the attention to the social and environmental situation of the individual whose physical status and medical diagnosis have been determined. This widening of the view that is taken of the individual to include various factors in his surroundings and human relations that may be detrimental to his health brings to the attention of the physician factors that may be detrimental not only to the individual patient, but also to those that are intimately associated with him, or to those who live as he does in his community or even to general problems of faulty hygiene and unsanitary conditions. If the physician gives proper attention to the emotional and social factors of the illness of his patient, he soon learns to appreciate the importance of personal conflicts, of family congestion, of lack of protection from infection, of adverse conditions of work and of nutrition, the lack of recreational and cultural opportunities, and other disadvantages to public health and preventive medicine that may affect the whole community. He may be impressed too with the inadequacies in the organization of medical care, and the difficulties that prevent people from getting medical care when it can be of most value, at the first evidence of illness.

It is obvious that the physical strain of various types of work must be appreciated in directing the activities of patients with chronic, limiting disease such as circulatory damage or pulmonary tuberculosis. It is equally important to evaluate the emotional stress and strain under which patients have to live, whether they have organic disease, personality disorders, or any other form of ill-health. Efforts of adjustment of the patient to his environment and of his environment to the patient are often necessary to bring the patient to

the optimum state of health that his particular conditions allow.

How attention to social and emotional problems may lead from the consideration of the individual to the recognition of and interest in problems of public health in which the individual is involved may be illustrated by some personal experiences.

A colored boy of about fourteen with pulmonary tuberculosis was visited at his home with a medical student and a public health nurse, in order to study the social problems related to his illness and to instruct the family in regard to the preventive measures that should be followed. It was found that this boy had been discharged because of his illness from a training school for delinquents. The nurse said that he was the fourth boy with tuberculosis whom she had recently visited after discharge from this institution. This experience immediately aroused my interest in this institution which had a year or so before been taken over by the State of Maryland from a private Board of Directors. This interest was a factor in my appointment by the Governor of Maryland to membership on the Board. Soon thereafter a conference at the institution was held with the Director of the State Tuberculosis Sanitoria, the Director of Communicable Diseases of the State Board of Health, the Health Officer of the county in which the institution was situated, a representative of the Maryland Tuberculosis Association, and the visiting doctor. The obvious plan of giving tuberculin tests to all of the three hundred inmates and of having chest x-rays taken and evaluated by an expert of all positive reactors was carried out. This plan has been followed with all new admissions during the past four years, and all active cases have been removed to a State Tuberculosis Sanitorium. During the time this plan has been in operation, the institution has been free of active tuberculosis and all suspects have been kept under observation.

Of course, the chain of events in this instance was unusual, as a number of unrelated factors were involved between the study of the tuberculous boy and the continuing interest in the health problems

of this State Training School for Colored Boys. It serves, however, to illustrate how the study of the social problems of a patient may reveal general needs and opportunities for public health activities.

Another example was a sixteen-year-old high school girl who complained of headaches, drowsiness, and back-pain of four months duration. Thorough examinations failed to reveal any physical abnormalities, but her emotional disturbance and attitude suggested early symptoms of schizophrenia. The interview of this girl and her mother brought out a difficult school situation with unsatisfactory grades that was magnified by a stern and exacting father. The study of this girl led us into an interesting school problem which was largely solved by effecting her transfer to a vocational school. The study of this case was of value to the principals of the high school and of the vocational school to which the girl was transferred. Also, to the school nurse and to the father, who was also interviewed. It was particularly the adjustment of the father that played an important part in not only restoring the patient to a state of happy girlhood, but relieved the emotional tension of the whole family so that the mother and the sister of the patient claimed that they were freed of disagreeable symptoms which definitely increased their sense of well being during the year or so this family was followed.

In this case lack of satisfaction in her studies, friction in the family group relationships, and consequent emotional disturbances interfering with success in carrying school work created symptoms for which the patient was brought to the hospital. It is a good example of the value of social adjustment in the treatment of illness and in the prevention of serious consequences of emotional strain treated by family education.

This case is cited, however, especially to indicate how the study of an individual may lead into an important field of public health, namely school hygiene. This experience served to stimulate an interest in the school authorities in the problems that they frequently encountered but which they tended to treat superficially and with-

out a very clear conception of their significance. Their point of view and analysis of this case was, however, of distinct value to those who were attempting to give proper attention to emotional and social factors of illness.

Many other problems of public health and preventive medicine could be cited to which the study of the patient as a person has led. These problems may be specific for the situation of the individual, or they may have wide significance. The important point is that medical practice should be organized so that the study of the patient as an individual leads freely and naturally into the study of the problems of preventive medicine, public health, and mental hygiene as related to that individual. The proper attention to the emotional and social factors of illness makes this transition natural and uninterrupted and leads to integration and correlation of effort. The practitioners of medicine and the workers in the fields of hygiene and public health should develop a better understanding of each other's methods, material, and accomplishments by working side by side.

Emotional and social disturbances may create emotional fatigue, taking its toll of mental and physical health. When this toll begins to be paid in terms of symptoms such as digestive discomforts, unusual muscular fatigue, headaches, sleeplessness, or cardiac palpitation medical advice is sought. The person becomes conscious of "social incapacity" and develops a sense of insecurity in performing the natural activities of living, which brings him to a doctor or to a clinic. In many instances, however, people with symptoms of emotional fatigue begin by taking medicines at the advice of the drug store clerk or show lively interest in the constant radio appeals to feed on laxatives and vitamins.

This sort of harmful medication could be prevented if the relations of the medical profession to the public were such that emotional strain could be considered as a reason in itself for seeking and obtaining medical care, before illness asserted itself. If people could

be educated to depend on doctors, or at least on certain types of general physicians for analysis and treatment of their emotional and social problems when they are first recognized, not only would there be fewer functional disturbances and personality disorders but also fewer cases of gastric ulcer, less asthma, perhaps fewer cases of chronic arthritis, and a diminution of arterial sclerosis, hypertension, and coronary disease.

If individuals were educated to the point of seeking positive health from the medical profession as well as the treatment of illness and disease, then the profession would learn to offer facilities and methods for meeting such needs. Such service is offered by some group practice in this country, and has been developed more fully by the Pioneer Health Center in what is called the Peckham Experiment (1) in England.

If the proper attention to the emotional and social factors is of the value in preventive medicine, in public health, and hygiene that we believe it to be, what should be done about it?

Three suggestions may be made.

First, greater emphasis should be given to an understanding of and methods of dealing with emotional and social components of health and of illness in medical education. Students should be trained from the beginning of their clinical experience to consider every patient as a person whose emotional status has an important relation to illness and health which requires study both from the point of view of the individual and of the social setting in which that individual has lived in the past and is likely to live in the future.

Secondly, efforts should be made in the organization of medical practice by groups, hospital staffs, and individual practitioners to provide for greater emphasis on positive health, of which the emotional and social factors play a larger part than is generally considered. An adjustment of the individual to the social problems he has to face and live with, and directions for living in a better state of integration with one's daily associates and family are apt to be more

valuable than vacations, regimes of diet, exercise, and the regulation of individual habits that are so often the beginning and end of medical advice, based on superficial or erroneous concepts of the causes of symptoms.

The third suggestion is that the proper attention to the role of emotional and social factors of illness would serve to make the bond between the medical profession and the public stronger than it is at present. Dissatisfaction is often expressed today in regard to the mechanical methods of medical care which represents a desire of patients for a deeper understanding of their personal problems than they receive. The strengthening of the bond between the profession and the public it serves would improve the integration of the profession in our social structure and put it in a stronger position to advance public health, hygiene, and preventive medicine.

Reference

1. Pearse, Innes H. and Crocker, Lucy H.: The Peckham Experiment, A Study in the Living Structure of Society. London, Allen and Unwin, 1943.

MORE ADEQUATE PROVISION AND BETTER INTEGRATION OF COMMUNITY FACILITIES

BAILEY B. BURRITT[1]

INTRODUCTION

I THINK we may safely conclude from the discussion presented in this Round Table that facts about the state of health of our population and about our newer knowledge present a real challenge to action. The volume of unnecessary sickness and disablement and the constant drain of lowered vitality is unnecessarily excessive and has a direct effect upon the economic efficiency of the Nation and the well being of its citizens. The situation calls not only for stepping up the volume of preventive health activities, but also for the introduction of new concepts and new functions into the total present program of public health and medical care activities carried on by our various communities.

The need for more adequate provision of community facilities to supplement those now available for public health and medical care can most fruitfully be examined in the light not only of existing concepts of public health and medical care, but also in the light of newer concepts now emerging in these fields.

NEW CONCEPTS OF PUBLIC HEALTH AND MEDICAL CARE

What are some of these emerging concepts? Public health activities in their earliest application centered around efforts to place at man's disposal under suitable sanitary control the use of water freed as much as possible from disease-bearing pollution; around the disposal of sewage in such manner that it would not be a continuous menace to health; around the protection of the food supply, particularly milk; and in general around controlling as much as possible the environment of man so that he could carry on with reasonable freedom from environmental menaces to his health.

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Subsequently with the later development of scientific knowledge about diseases spread by harmful bacteria, public health activities were enlarged in an attempt to control infectious diseases. The sanitary control of the environment and the control of infectious diseases thus become two basic factors in public health endeavors. More recently the protection of maternity and infancy has been added as an additional basic function of departments of health.

Now we see emerging in discussions about public health some newer concepts. One of these is the concept of the maintenance of health as a primary objective with the prevention and treatment of disease subordinated to this objective. Another is the recognition of the fact that the maintenance of health is at present seriously handicapped through inadequate facilities for determining departures from normal healthy conditions of individuals sufficiently early to bring disease under control without undue expenditure of effort and without an excessive amount of unnecessary sickness and death. It is beginning anew to be recognized that periodic health inventories are a necessary adjunct to the maintenance of health. Another of the newer concepts has already been developed in this round-table discussion, namely the fact that if we wish to maintain health and prevent disease we must give more attention to the role of nutrition in health and disease. Still another of the newer concepts is the fact that you cannot maintain health without greater recognition than prevails at the present time in public health and medical care activities of the fact that we must of necessity recognize that we are dealing with personalities in our efforts to control diseases. This has also been developed during the course of the discussion of this Round Table. But as an extension of that concept I would emphasize the emerging concept of the fact that the family is in reality the biological unit and that we must deal with this fact in the science and art of public health and medical care.

Health education is another of the newer concepts or at least newer concepts in public health education are involved. Additional

newer concepts that are affecting our thinking and beginning to affect our programs of public health might be mentioned. Without extending this part of my discussion I should not conclude without mentioning the fact that it is now being recognized more fully than ever before that recreation and rest are essentials in the maintenance of health and are relatively neglected in our programs of public health and medical care. Finally, also, I would mention the fact that the concepts of public health and medical care are both undergoing a change. Progressive thinking is increasingly in terms of something more than the treatment of sickness. It is beginning to bear directly upon the maintenance of health.

Periodic Health Inventory

Shall we examine first the need for provision for more adequate health inventory facilities? The total experience in our efforts to control tuberculosis, cancer, diabetes, nutritional deficiency, and other important diseases that prevent the maintenance of health clearly indicate that only as we discover departures from normal health very early can we hope to maintain health. At present our facilities for examinations are for the most part limited to examinations of persons already known to be diseased. The rapid expansion of x-rays as a means of discovering tuberculosis early is an important exception to this, but even here we confine our examination all too exclusively to an examination to discover and control tuberculosis, overlooking relatively the fact that even the person afflicted with tuberculosis needs a careful general health inventory and careful attention to other departures from normal healthy conditions. But the point which I am making is that most of our present energy and resources in public health and medical care are absorbed in attention to the treatment of pathological situations already so far developed when they are discovered that the arrest of the difficulty and restoration of the individual to the condition of positive robust health is a difficult, long-time process, if indeed it can be accomplished at all.

It is difficult to see how in the light of present knowledge and experience the health of our population can be maintained at any acceptable standard without focussing our attention upon the development of community facilities by which all of our citizens may have necessary periodic health inventories.

This would seem to involve the establishment of diagnostic and consultation facilities which either do not exist at all or are totally inadequate in quality and quantity. In metropolitan areas like New York City with which I am most familiar such facilities should be made available on a neighborhood basis, easily accessible to our citizens not now able to avail themselves of such facilities and readily available to practicing physicians of the neighborhood. Such neighborhood centers should be in charge of a thoroughly competent medical officer whose training and point of view would be not only that of the diagnostician and consultant, but even more fundamentally that of an officer charged with the responsibility, with the help of the practicing physicians and public health nurses of the neighborhood, of maintaining the health of citizens through teaching health as well as discovering and treating early disease. Through the cooperation of hospital facilities, he should have the assistance of a group of medical men who would make possible a specialized group approach to the problem of the maintenance of health and the early discovery and prevention of disease. Such a group, providing leadership and working in the closest cooperation with practicing physicians in the treatment of discovered diseases, could anticipate and prevent much of the present needless waste of human material. Neighborhood centers of this type would also need a staff of public health nurses to assist the physicians in the health teaching of families both at the centers and in their homes. Similarly, because maintenance of health is inextricably tied up with social problems, the physician and the nurse should have ready access to the public and private relief and case-work facilities of the community and these should be adequately staffed to make such services possible.

The Family and Its Environment as a Unit

The maintenance of health and the prevention of disease and all medical care has to deal with an individual as an integral part of a biological unit, the family. This is basic in the program of the Peckham Center as brought out in the presentation of Dr. Baehr. It is recognized increasingly in maternity work, in much of the health teaching of public health nurses, and in limited ways in other health and medical care activities. It is not, however, generally accepted *in practice* in public health work nor in medical care, however much it may be accepted *in theory*. It is an essential basic concept in the newer advances in the field of public health. It is as a member of a family unit that a babe is born and the infant and child is nourished. His health for his whole life span is influenced greatly—in some instances predetermined—by beneficial or adverse influences centering in the home and family. The nutrition of all members of the family is more or less controlled by the family unit and not by each individual member. The habits of the family as a whole determine to a large extent the rest and recreation of its members. Health teaching and medical advice given to the individual in the clinic or private office all too frequently are futile because they are not given in the full light of the family and home situation. The whole home itself whether adequate or inadequate as an environment for health is a family more than an individual concern. Recognition in public health practice of these facts is essential if the maintenance of health is to be the concern of public health activities.

How then, does this affect the adequacy of present community public health and medical care facilities? More time of physicians and of nurses will inevitably be necessary if attention is to be given to the health of each individual member of the family in the setting of the family as a unit. The provision of neighborhood diagnostic and consultation facilities referred to earlier should facilitate greatly the process of dealing with family units in health matters. Directly bearing on this also is the necessity of a greater amount of integra-

tion of the work of public health authorities, practicing physicians, and hospitals about which I shall speak more fully. Meantime, however, I would emphasize in this connection that the maintenance of health rather than the treatment of disease should be the keynote in dealing with the family as a unit. Public health departments of the future as the natural representatives of the people as a whole in the maintenance of health and the prevention of disease should embrace the opportunity for more aggressive leadership in this direction.

Public Health Education

I have already referred to the fact that new concepts of public health education should be considered in this connection. To be sure, health education has been an objective of public health activities for a long period of time. What we are now observing, however, are new expanding concepts of public health education. We are realizing more than ever before that health education aimed at the education of the masses must be supplemented by effective and intensive education of groups, families, and individuals. We are recognizing more fully that in health education we fail except as we secure action. This means that health education must actually *motivate* action. To do this, it must reach and influence the personality of each member of the family unit, and this emphasizes again that in health education *the family is the significant unit.*

These newer concepts require more carefully thought out plans of public health education. Each piece of mass education through the radio, newspaper, posters, etc. must be prepared in the light of motivating action and then must be tested to determine whether it has this result. Similarly, each item in the plan for group teaching or for teaching family units and individuals must be definitely planned to motivate action and be tested for results.

This emphasizes the fact that much more attention must be given to the techniques of teaching by those interested in the maintenance

of health. Departments of health must have more adequate facilities for teaching health. The health-teaching function must be broadened to include not only mass education, but the stimulation and training of physicians and nurses to do a much more comprehensive, extensive, and intensive job of teaching groups and families. This effort should not be limited to the members of the department itself, but should include practicing physicians of the community. These should become teachers of the maintenance of health and the prevention of disease for all of the families with whom they come in contact.

One other implication of this is the fact that in this educational function the educator should be utilized more adequately. Sole reliance on the physician for public health teaching is based on the unsound premise that because a man has been trained to recognize and treat disease he has at the same time been trained in the knowledge and art of teaching people. It is also based on the further not wholly tenable premise that because he is trained in the treatment of disease he is also trained and qualified as a leader in the art of teaching the maintenance of health and the prevention of disease to children and adults, to families and groups, or to the population en masse.

As long as these assumptions are maintained in practice we shall continue to fall short of possibilities in one of the main objectives of health work—that of maintaining health through public health education that leads definitely to the adoption in the habits of daily life of the facts accepted by science as essential to the maintenance of health.

We need then to supplement our departments of health with the consultant trained in the art of teaching and also thoroughly familiar with the subject matter to be taught. With a medical staff more adequately trained in the art of the maintenance of health and with an adequate staff of public health nurses supplemented by educational consultants more intensive and more effective health educa-

tion of the whole community and all of its family units with their individual members should be possible. This will not attain its full possibility, however, unless departments of health exert real leadership in utilizing not only their own staff for teaching purposes, but all of the physicians and public health nurses of the community. Each one of these should be encouraged and stimulated to become an energized unit of health education.

Better Integration of Available Facilities

In the limited time at my disposal I have attempted to point out the need for additional community facilities to meet some of the needs arising particularly out of newer concepts in public health.

It is appropriate, however, when considering new facilities to meet new needs to give thought to the possibility of more efficient results from existing facilities. One fact that continually disturbs those of us who are concerned with public health and medical-care problems is the rigidity of community organization of its health agencies. We must of course have separate public departments and separate bureaus within departments and we must have a variety of voluntary organizations. To the family concerned with its health, however, it all too frequently looks like confusion. I might give many illustrations. Let me give only one: A case of tuberculosis in the family is found presumably in the clinic of the Department of Health, or in New York City, a clinic maintained by one of the hospitals of the City. After diagnosis the patient is urged to go to a hospital or sanatorium. This is maintained by another department, contact with which must be made by the family. If the family is in need of the necessities of life it is referred to a third public department and undergoes a searching even if friendly inquiry as to its financial ability by a staff member of this third department. If there is need for bedside care at home while arrangements are being completed for entrance into the hospital, a voluntary organization is called in and a staff member of a fourth organization appears on the

scene. If, now, the family situation has social and behavior problems other than economic maintenance a case worker from a fifth organization is called upon. If the nursing services available in the official department are insufficient to look after the necessary health teaching of the family together with their other responsibilities, still another voluntary nursing organization is called upon and the staff person of a sixth organization is introduced. Then when the patient is ready for physical rehabilitation a department of the State of New York is called upon and this is frequently supplemented by another separate and voluntary organization. Meantime, the patient and the members of the family have been passed along from one medical authority to another with all too little suggestion of continuity in medical personnel, in availability of medical history, or in treatment.

There is not only rigidity and lack of smooth coordination and transition as between separate public departments and voluntary organizations, but there is also almost as much lack of effective connection between different services of the same organization. The tuberculous family which has an expectant mother or a new baby is looked after by another branch of the Department of Health. This introduces new medical and nursing staff too often without any intimate sharing of knowledge of what has gone on with regard to what other physicians and nurses have been doing for tuberculosis in the family. If members of the family have other ills they are, if not neglected, apt to be looked after in a crowded separate clinic of a hospital for each of the ills of each member of the family without these clinics sharing fully with each other their experience with the family, thus, other groups of professional workers come into the confused family picture.

I am not suggesting that these services are more extensive than needed by the family even with the help of all of these organizations and their professional staffs. The real help which is needed by the family is apt to be intermittent, inadequate, spread very thin, and

without any particular evidence to the family of unity or continuity in dealing with the family problems.

This is in part due to inadequate professional staffs of public departments. Because they are inadequate in quantity and too frequently in compensation and opportunity, the result leads often to inadequate quality of service. The lack of unity and continuity, the confusion and the inadequacy are all aggravated by the lack of well-planned organization of the community's facilities to secure continuity of competent, sympathetic, professional attention to the needs of families suffering from ill health, or still less the needs of those families who are attempting to maintain their health.

In addition to the lack of adequate attainment of integration of the services of public and private health organizations there is also the fact that there is all too little provision in our organization of community health facilities for tying in the work of the practicing physician closely and effectively with the work of both public and private health services. If this could be well planned and integrated it could add greatly to what can be accomplished both by the physician and by the organized services so that the total volume of health and medical care of the community could be made at once more adequate and more successful in its results.

As a matter of fact it must be recognized that our community facilities have not been developed in accordance with any well considered community plans. As we have felt the need for more specialized and additional health services we have proceeded to get them under way more or less irrespective of any general community plan of inter-relationship. And yet in spite of this they have enriched the health possibilities of the community. We have arrived at the stage, however, particularly in our cosmopolitan areas where we now need to focus our attention upon the necessity of securing a greater integration of existing services. Only as we secure the advantages of this can we be convincing in urging the development of much needed new facilities.

In what I have developed in these brief remarks I have as you realize spoken more or less completely from the point of view of a worker in a cosmopolitan urban area. The underlying point of view of approach, however, is the same as for rural areas. Frequently because of the lack of many facilities in rural areas and the relative simplicity of their organization it may be possible to secure a more adequate unification and integration of services as they are developed if the need for these is continuously kept in mind.

In concluding this discussion you will readily understand that I am somewhat skeptical as to the value of continuing to multiply facilities in the field of public health and medical care without adopting some much-needed new points of view of approach to the problem of the maintenance of health and the prevention of disease. The adoption of such new concepts will inevitably require not only new facilities, but also the adaptation of existing facilities to implement them. This is the note that I would most emphasize.

THE ROLE OF NUTRITION IN PREVENTIVE MEDICINE

F. F. TISDALL, M.D.[1]

FROM the public health standpoint we are not concerned with the so-called nutritional deficiency diseases. They do not constitute a public health problem. For instance, at the Hospital for Sick Children in Toronto, in 1925 we had 154 cases of rickets. Ten years later, in 1935, in place of 154 cases, we had four. The medical student today goes through the University of Toronto without ever seeing a case of rickets.

We average seven cases of scurvy a year, and the attendances at the hospital approximate 100,000 per year. In the last one and one-half million attendances at the hospital, we have had one case of xerophthalmia, and beriberi and pellagra are unknown. These nutritional deficiency diseases do not constitute a public health problem for us.

Where does nutrition enter into public health? From dietary surveys made in the United States and Canada, it would appear that as many as one-third of the populations of both countries are receiving diets which are not in line with optimum health. The dietary deficiencies can be regarded as of moderate degree rather than severe. The deficient intake, however, tends to be of long duration. Dr. Kruse (1) some two years ago pointed out that the abnormal conditions which develop as the result of a chronic moderate lack of various nutrients not only develop slowly but also respond slowly when the deficiency is corrected.

In addition to the question of chronicity, one must keep in mind that the signs of ill health and impairment of efficiency appear under periods of stress and strain. A diet that may be markedly defective does not interfere with the efficiency of the individual if he is spending his time in bed. He can still be a very efficient bedridden individual; but if he is active, carrying on in this busy life,

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the diet may not be sufficient to give him optimal health. This is the second point to emphasize, namely, the effect of stress and strain on nutritional requirements.

Do not forget that all the nutritional work on animals has been done, or most of it has been done during the period of growth, under the stress and strain of growth. There is the strain of pregnancy, the strain of severe exertion, both mental and physical. There is the strain of exposure to unfavorable surroundings, such as toxic materials. There is the strain of extremes of climate, hot and cold, and wind and glare, and there is the strain of infection.

When one examines the evidence showing the effect of diets that are not perfect, but still good enough to prevent any deficiency disease, one is led to the conclusion that there is no one single factor today which so affects the health of the individual as the food he eats. Now, what evidence do we have to support this rather sweeping statement?

Table 1. Weekly amounts of food supplied.[1]

Type of Food	Weekly Amount
Milk	10 Pints (Imp.)
Tomatoes	32 Ounces
Wheat Germ	14 Tbsps.
Viosterol	2,000 I.U. Daily
Eggs	7
Oranges	7
Cheese	½ Pound

Analysis of Daily Food Supplied

Protein (gms.)	Fat (gms.)	Carbohydrate (gms.)	Calories	Calcium (gms.)	Iron (gms.)
45	46	60	840	1.45	.015

[1] Ebbs, J. H.; Tisdall, F. F.; and Scott, W. A.: The Influence of Prenatal Diet on the Mother and Child. The Milbank Memorial Fund *Quarterly*, January, 1942, xx, No. 1, pp. 35-46.

The first study shows the effect of food on the child, the unborn child. While we are speaking of the unborn child, we will also consider the effect of food on the pregnant woman. In Toronto Dr. Ebbs (2) (3) and those associated with him studied three groups of women coming into the prenatal clinic. Today we will consider only two groups—mothers that were on a poor diet and mothers on the poor diet but given additional foods through the generosity of a Toronto business man. The extra food supply, shown in Table 1, included an egg a day, thirty ounces of milk, an ounce of cheese, about four and one-half ounces of tomatoes, an orange a day, one-half to one ounce of wheat germ, plus some vitamin D.

The women in the poor-diet group were originally getting 55 grams of protein a day, although they should have been getting 85 to 100. They were taking only 1,600 to 1,700 calories, yet they could easily have eaten more bread, more food which they had in the house. They should have been taking 2,500 calories. Their calcium was half a gram instead of 1.5 grams and their iron was 10 instead of 15 mgs.

Before the women in the other group were given the additional food, their diets were similar to those in the poor-diet group. In place of 55 grams of protein, they were getting 57; they were receiving 1,660 calories. The calcium intake was .5 grams, the iron intake was 10 mgs. The two groups of women were identical in so far as we could determine from the standpoint of their nutritional intake.

The women in both groups were observed throughout pregnancy. The obstetrician had no idea in which group they belonged.

Later on, when subsequent surveys were made, it was found that the diets of the poor group had improved very little; 55 to 64 grams of protein per day, the intake from calories was from 1,600 to 1,900, from .5 to .7 grams of calcium, and from 10 to 11 mgs. of iron. Those who were given the extra food had reached an approved level; the increases were from 57 to 97 grams of protein, from 1,600 to 2,500 calories, from .5 to 1.6 grams of calcium, and from 10 to 24 mgs. of

iron. None of the women in the poor diet group had any signs of any deficiency diseases, yet they were not efficient as pregnant women bearing healthy, normal children.

The prenatal ratings by the obstetrician, which appear in Table 2, show that 36 per cent of those in the poor-diet group had a poor or bad record as compared to only 9 per cent when the diet was made good.

Table 2. Prenatal rating by obstetricians.[1]

Quality of Diet	Rating	
	Good—Fair	Poor—Bad
	Per Cent	
Poor Diet	64	36
Supplemented—Good	91	9
Good Diet	87	13

[1] Ebbs, J. H.; Tisdall, F. F.; and Scott, W. A.: The Influence of Prenatal Diet on the Mother and Child. The Milbank Memorial Fund *Quarterly*, January, 1942, xx, No. 1, pp. 35-46.

The ratings by the obstetricians of the conditions during labor are shown in Table 3. Twenty-four per cent of the mothers in the poor-diet group had a poor or bad record as compared to only 3 per cent when the diet was made good. There were, roughly, one hundred women in each group.

The average duration of the first stage of labor is presented in Table 4. The women (primipara) in the poor-diet group took 20 hours as compared to 15 hours when the diet was good. The multipara on the poor diet took 11 hours against 9.5 hours for those on the good diet. The latter were more efficient women.

Table 3. Rating by obstetrician of condition during labor.[1]

Quality of Diet	Rating	
	Good—Fair	Poor—Bad
	Per Cent	
Poor Diet	76	24
Supplemented—Good	97	3
Good Diet	94	6

[1] Ebbs, J. H.; Tisdall, F. F.; and Scott, W. A.: The Influence of Prenatal Diet on the Mother and Child. The Milbank Memorial Fund *Quarterly*, January, 1942, xx, No. 1, pp. 35-46.

During convalescence the record is similar to that during labor; 11.5 per cent gave a poor or bad record when they were on the poor diet as compared to 3.5 per cent when the diet was made good.

In regard to the effect on the child, the condition and progress of the baby during the first two weeks, 14 per cent of the babies from the mothers who were poorly nourished gave a poor or bad record as compared to none who came from the mothers who were well nourished.

Table 4. Average duration of first stage of labor.[1]

Quality of Diet	Hours	
	Primipara	Multipara
Poor Diet	20.3	11.1
Supplemented—Good	15.2	9.5
Good Diet	18.3	9.9

[1] Ebbs, J. H.; Tisdall, F. F.; and Scott, W. A.: The Influence of Prenatal Diet on the Mother and Child. The Milbank Memorial Fund *Quarterly*, January, 1942, xx, No. 1, pp. 35-46.

It was recognized that data of illnesses during the first six months of life perhaps will not bear the scrutiny of most careful study because they are defective to a degree since they are dependent on the statements of the mothers themselves. As far as could be determined, the babies in the two

Table 5. Principal illnesses in babies during first six months.[1]

Cause of Illness	Quality of Diet		
	Poor	Supplemented—Good	Good
	per cent		
Frequent Colds	21.0	4.7	4.7
Bronchitis	4.2	1.5	5.7
Pneumonia	5.5	1.5	0.9
Rickets	5.5	0	0.9
Tetany	4.2	0	0
Dystrophy	7.0	1.5	0
Anemia	25.0	9.4	17.1
Deaths	3	0	0

[1] Ebbs, J. H.; Brown, A.; Tisdall, F. F.; Moyle, Winifred J.; and Bell, Marjorie: The Influence of Improved Prenatal Nutrition Upon the Infant. *The Canadian Medical Association Journal*, 1942, 46, pp. 6-8.

groups received the same care after they left the hospital, yet, as can be seen in Table 5, the record indicates that the babies from the poorly fed mothers had many more colds than the babies of the mothers who were well fed.

The babies of poorly fed mothers had a higher proportion of each of the principal illnesses occurring during the first six months of life than did the babies of well fed mothers. For bronchitis the percentages were 4 and 1.5, for pneumonia 5.5 and 1.5, rickets 5.5 and none, tetany 4 and none, dystrophy or difficult feeding babies 7 and 1, and anemia 25 and 9.

The most striking results of the whole study are shown in Table 6. There were 14 babies lost, 7 from miscarriages, 4 from stillbirths, 2 from pneumonia, and 1 from prematurity. Every baby lost came from the mothers who were poorly nourished.

This study is evidence that a diet that is not optimum, although still good enough not to produce any clinical conditions which could be recognized, interfered with the efficiency of these women.

Table 6. Miscarriages and infant deaths.

	Quality of Diet		
	Poor Diet	Supplemented—Good	Good Diet
	number		
Total Patients	120	90	170
Miscarriages	7	0	2
Stillbirths	4	0	1
Deaths: Pneumonia	2	0	0
Prematurity	1	0	0
	14	0	3
Congenital Malformations	1	3	2
Prematures	9	2	5

They were not as efficient as they should have been in producing healthy, normal children under this period of stress and strain.

Now the next subject to be considered is the effect of diet on growth. Back in 1926 in England, Corey Mann (4) and in 1928 Sir John Boyd Orr (5) showed that the administration of extra food at noon markedly increased the rate of growth as measured by height and weight of children. In 1930, Agnes Fay Morgan (6) showed that the giving to one group of children of a biscuit or muffin containing a large amount of wheat germ resulted in a more rapid rate of growth.

The records of the University of Toronto freshmen show that 1,000 freshmen of an average age of 19 years, examined in 1920-1921, had an average height of 5 feet 8 inches and an average weight of 138 pounds (7). Seventeen years later, in 1937, in a similar group of the same age, there was a gain in height of 1.5 inches and a gain in weight of 5.2 pounds. One cannot say definitely that this is due to better diet, but better diet is the one marked change that has occurred in those twenty years.

Similar results were obtained in another study in Toronto (8) where 78,000 Toronto school children were measured in 1939 and compared with the measurements taken on 48,000 school children in 1923. The child in Toronto in 1939 was the same height and weight as a child one and one-half years older in 1923; that is, at the age of 9.5 years in 1923, the school child of Toronto was the same height and weight as a school child today is in Toronto at 8 years of age. Again, this study furnishes indirect evidence that better nutrition affects the rate of growth.

Another study shows some work that was done at the Hospital for Sick Children in 1932 (9). Dr. Summerfeldt took a group of children at an orphanage who were fed a very good diet. The diet included, among other things, twenty-four ounces of milk a day; one ounce of butter; meat, three to five times weekly; eggs, one to seven weekly; potatoes and one or two other vegetables daily;

and fruit throughout the year. The children had a reasonably good diet.

Two groups of these children were taken. One continued on the regular diet of the institution and the other group, in addition to the regular diet, was fed daily a vitamin B complex in the form of a concentrate made from wheat germ and brewers' yeast, which weighed only six grams, a very small pill. The rate of gain of the control group is essentially the expected rate, yet the children who were fed the vitamin B complex grew much faster. From this study one can conclude that, taking a diet that is already fairly good, that diet can be improved and the children with the improved diet grow larger and heavier than they otherwise would. Diet has a profound effect on growth.

As to the effect of infection on one's resistance to disease, there are many hundreds of references in the literature. The only study which will be referred to is the work done at the Hospital for Sick Children in Toronto (10).

Dr. Elizabeth Chant Robertson at the Hospital for Sick Children took animals and divided the litter mates into two groups. One group received a diet lacking in the food substance to be tested; it was not completely left out in many instances, but it was reduced. The litter mates received the same diet, but the missing element was present in optimal amounts. After the rats had been on these respective diets for a certain length of time, they were then given a measured amount of disease-producing organism, Salmonella muriotitus, and the number of survivors noted. The results are shown in Table 7. When the diet was lacking in vitamin A, 40 per cent of the animals survived compared with 79 per cent of those on an adequate diet.

In another year, using different dosages, because the dosages had to be regulated very carefully—if you gave too large a dose you would kill all the animals; if you gave too small a dose they would all live—when the B complex was reduced, 20 per cent survived as

compared to 72 per cent surviving when the diet was perfect. When vitamin D was lacking in the diet, 28 per cent survived as compared to 55 per cent of the litter mates that were on the perfect diet. When the minerals were low, 54 per cent survived as compared to 87 per cent when the diet was perfect. When the animals got their protein, all from sources other than animal proteins, 40 per cent survived as compared to 90 per cent when there was some casein added to the diet.

In this one table there is evidence that almost any one of the thirty-odd food substances necessary for life, if reduced in amount, will lower resistance against infection.

Now in regard to physical strength and vigor, Dr. Russell M. Wilder reported in May 1942 (11) that when individuals on a diet low in thiamin had thiamin restored to the diet, the measured capacity for physical work was doubled.

In the fall of 1942, the work from the Harvard Fatigue Laboratory (12) came out along these same lines, as did also the work of Dr. Ivy and his coworkers in 1943 (13).

A summary of some of the work from the Harvard Fatigue Laboratory is as follows:

"Over a period of five days, men receiving a diet lacking in all mem-

Table 7. Effect of improper nutrition on resistance to infection.[1]

Food Substances Deficient	Number of Animals	Survivors on Deficient Diet	Survivors on Adequate Diet
		Per Cent	
Vitamin A	24	40	79
Vitamin B	151	20	72
Vitamin D	739	28	55
Minerals	124	54	87
Animal Protein	81	40	90

[1] Ross, John R. and Robertson, Elizabeth Chant: The Effect of Vitamin B Complex on the Resistance of Rats to Enteritidis Infection. *American Journal of Diseases of Children*, March, 1932, 43, p. 547.

bers of the B complex showed deterioration in capacity for easy work. The men receiving thiamin remained normal in this respect." In other words, if all the B complex was reduced, on easy work the men showed deterioration, but if they got thiamin they did not. "For exhausting exercise, there was a progressive, marked deterioration in the fitness of both groups." This again illustrates the effect of strain.

"The daily administration of 18 grams of dried brewers' yeast resulted in a complete return to normal in both groups in five days, the thiamin group improving more rapidly."

"A lack of thiamin results in symptoms of lack of well-being, irritability, muscle pains, and moderate impairment of physical efficiency. A lack of the other members of the B complex is characterized by few symptoms, but by marked impairment of capacity for hard work."

Poor diet can definitely affect the mental outlook of individuals. Wilder first brought to our attention the effect of a low thiamin intake on mental reaction; he found that individuals on a low intake of thiamin became irritable, morose, and were upset with little things.

In the study of pregnant women made in Toronto, one of the first evidences of change that was observed in the women when their diets were improved was a change in their mental outlook. Before improvement of their diets they were worried about everything, the whole business was a trouble to them, housework bothered them, they were unhappy; when they came back after three weeks on a good diet their faces were washed, their hair was brushed; if they could get a new feather they stuck it in their hat. As Sir John Boyd Orr remarked, "Don't forget, a woman during the childbearing age who is not interested in her appearance has something wrong physiologically." These women became definitely interested in their appearance.

In regard to the effect of diet on learning ability, Mauerer and Tsai (14) in 1930 showed that if you took newborn rats and had them nurse for three to four weeks from mothers who were receiving a diet lacking in the vitamin B complex, these young rats did not

learn as rapidly as their litter mates or other rats that had received a perfect diet.

Table 8 shows the results of a similar study done in 1934 by Bernhardt at the Hospital for Sick Children in Toronto (15). This study was essentially repeating the work of Mauerer and Tsai, except that instead of a maze with food as a reward, a maze with getting out of water as the reward was used, and the rats had to learn to go through the maze. Half of them were on a vitamin B complex deficient diet for the first four weeks of life. Then they all went on a perfect diet and at four months of age the deficient rats were almost the same weight and had the same physical appearance as the control rats. Yet, when these rats had reached four to six months of age, which would correspond to about ten years of age in the human life, and were tested as to their ability to learn to go through the maze, a striking difference was noted. As shown in Table 8, the control group learned to go through the maze on an average of twenty-eight trials; the B deficient rats took forty trials. The average time required for the control group was 1,289 seconds; the deficient rats took 1,705 seconds. The average errors were 141 as compared to 201. The average retraces; that is, where the rat goes into the wrong part of the maze and has to go out again, were 26 against 33. The excess

Table 8. The effect of Vitamin B Complex during nursing on subsequent learning in the rat.[1]

	Maze Scores	
	Control	B. Deficient
Average Trials	27.8	39.8
Average Time in Seconds	1,289.3	1,705.2
Average Errors	141.1	200.7
Average Retraces	26.4	33.2
Excess Distance	357.2	495.0

[1] Bernhardt, Karl S.: The Effect of Vitamin B Deficiency During Nursing on Subsequent Learning in The Rat. *Journal of Comparative Psychology*, 17, No. 1, February, 1934.

distance traveled was 357 as compared to no less than 495 in the B deficient rats. In other words, a lack of vitamin B complex during early childhood of these rats impaired their ability to learn when they were at the comparable age of 10-year-old children in the human scale. In brief, these rats were stupid.

The most recent work with humans is that of Miss Harrell (16), who took children at an orphanage and divided them into two groups. It was estimated that the average intake of thiamin of the children at the orphanage was .9 mg. daily. One group was given a placebo. The other group was given 2 mgs. of thiamin which gave them a total of 2.9 mgs. Then the children, 37 in each group, were most carefully tested as to their learning ability by means of 18 different tests. At the beginning of the study there was no essential difference between the two groups, the A group and the B group, as to their relative standing in all of the 18 different tests which combine both mental tests, such as addition, subtraction, multiplication, and so on, with physical tests, such as throwing darts, balls, and strength of the hands.

After six weeks, in each of the 18 tests, the B group getting the 2.9 mgs. of thiamin had gained much more than the control group that was getting .9 mg. The requirements for these children, who ranged from 9 to 19 years of age, would vary according to the National Research Council standards, from 1.2 to 2. I am sorry that this figure of .9 was a calculated figure and not an actual assay figure, because we have found from experience in the Royal Canadian Air Force that calculated figures sometimes bear little resemblance to the actual figures after the food has been cooked. I would suspect that this figure of .9 might be a little lower, but in any case it was considered a good diet in this institution, yet when they got an adequate amount of thiamin their learning ability was much greater than when they did not. The increase was 27 per cent greater in the group receiving the additional thiamin. This is very striking indeed.

Definite psychiatric changes can develop as a result of dietary de-

ficiencies. The work of Wilder, Jolliffe, and Sydenstricker, particularly in regard to older individuals where marked psychiatric changes are present, has demonstrated that these changes respond dramatically to the administration of adequate amounts of niacin.

Then we come to the effect of weather, the stress and strain of extreme heat and extreme cold. Studies have been made on Indians in northern Canada, who in addition to having diets that are markedly deficient in many respects are exposed to cold and tremendous glare from the reflected light from the snow. In addition, their lives demand extreme exertion. Marked pathological changes were noted in many tissues, including the eyes, and it would appear that the climatic conditions greatly aggravated these changes.

Twenty-five years ago Professor McCollum (17) fed animals wheat, corn, vegetables, potatoes, peas, beets, turnips, and dried beef, a diet not far different from any diets used throughout the world in certain places today. Animals at ten months of age, comparable in the human life to between 18 and 20 years, had all the appearance of old age.

It is true that the diet fed these animals was not very good; but that diet is being used today in certain parts of the world.

Sherman's work (18), reported in 1930, will illustrate the effects of a diet that is good. He took a diet (Diet A) that was already good and consisted of a mixture of one-sixth dried whole milk and five-sixths ground whole wheat, table salt, and distilled water. Families of experimental animals, rats, were still thriving at twenty-one successive generations on this diet.

Diet B had the proportion of milk powder in the food increased to one-third. The two groups of animals were of the same heredity and were kept under identical conditions.

On Diet A the rats lived an average of 590 days, while on Diet B they lived an average of 654 days, an increase of 64 days or 10 per cent. From further investigations it seems probable that the increased intakes of calcium, vitamin A and of perhaps B_2 all have

contributed to the higher degree of health and the increased length of life. The most significant conclusion is as follows: "Hence, it may be regarded as established beyond any reasonable doubt that starting with a diet which is already clearly adequate, it may still be possible to induce a very significant improvement in longevity by enriching the diet in certain of its chemical factors."

I have attempted to take you from before birth right through life to show you how a diet that is not adequate in all respects but still does not produce any well-marked clinical entities can affect the health and efficiency of the individual. It was in 1877 that Disraeli said, when he was then Prime Minister of England: "The health of the people is really the foundation upon which all our happiness and all our powers as a state depend." And there is no one factor which so affects the health of the people as the food they eat.

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NUTRITION — ITS PLACE IN OUR PRENATAL CARE PROGRAMS

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IN any consideration of prenatal nutrition, we might well attempt to answer these questions: (1) Does prenatal nutrition deserve a place of major importance in our public health and medical care programs? (2) Have we adequate proof that a program to improve the nutrition of women during pregnancy would result in marked benefits in child health and development and in maternal health? (3) If there is clearcut evidence in the affirmative, why does nutrition during pregnancy not occupy a more important place in our prenatal care programs?

Those of us who have been primarily interested in the problem of nutrition during the prenatal period find it difficult to understand why the medical profession has been so slow in its appreciation and acceptance of the importance of nutrition in prenatal care. Growth begins with conception, not with birth, but it is the pediatrician who first concerns himself primarily with the growth and development of the child—his work begins with the birth of the baby. The obstetrician is interested primarily in seeing that the mother goes through pregnancy, labor, delivery, and the postpartum period without undue hardship, and he has been accustomed to assume that if the course of her pregnancy is uncomplicated, the baby will in all probability be reasonably healthy. His interest in diet during pregnancy except insofar as it relates to excessive weight gain during that period and to the giving of concentrates such as iron, calcium, or vitamin D, has been slow to develop, because he has not been convinced that diet during pregnancy is of great importance to the health of the mother or to the health and development of the fetus.

Over a long period of years it has been repeatedly emphasized

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that pregnancy is a period of rapid growth and that the increased nutritional requirements of this period together with frequent impairment of the digestive system, especially in the early months, make careful attention to the diet of the mother doubly important. There are frequent examples of the fact that the increased requirements of this period superimposed upon a mild deficiency (due to what we may term a suboptimal normal dietary intake) result in frank deficiency symptoms in the mother. It is possible to review the literature and find many illustrations of fetal damage resulting from prenatal dietary deficiency of various types. Not only is this true in animal experimentation, such as the work of Dr. Warkany and his associates (1), but there is a surprising amount of evidence of damage to the human fetus also due to inadequate maternal nutrition. It is, however, only within the last few years that interest in the science of nutrition has developed to a point where there have been collected data as to what women actually consumed during pregnancy and these nutritional findings evaluated in relation to the mother's condition during pregnancy, labor, delivery, and the postpartum period and to the condition of the infant at birth. The work of Ebbs, Tisdall, and Scott (2), for example, is an important contribution in this field and has done much to stimulate the interest of the medical profession in this important phase of nutrition.

As a part of the research program on the growth and development of the well child undertaken by the Department of Child Hygiene of the Harvard School of Public Health, a study of the influence of diet during pregnancy upon fetal growth and development as well as upon the course of pregnancy, labor, delivery, and puerperium has been made. Data have been collected on 324 women and their infants. The published data are on 216 women and their infants, in each case the oldest sibling of that family in the study. The women were drawn from the prenatal clinics of the Boston Lying-in Hospital. Approximately 90 per cent of the parents of these children are of Northern European stock and from an economic standpoint

represent the average "middle class" family. The majority of the women were between 20 and 30 years of age and 60 to 70 per cent were primiparae. These women were examined periodically during pregnancy, labor, delivery, and postpartum period by the obstetricians attached to the hospital staff; those in charge of this phase of the study were also members of the research staff. Detailed nutrition histories were obtained at regular intervals. These were supplemented by food records which the women kept. The diets were evaluated in relation to a set of nutritional standards which approximate the values later recommended by the Food and Nutrition Board of the National Research Council (Table 1). Each nutritional essential was rated on the basis of the woman's average daily consumption as "excellent," "good," "fair," "poor," or "very poor"—each rating representing a numerical range in relation to the standard which was called "excellent." The obstetrician and, within forty-eight hours of birth, a pediatrician from the study examined each infant and evaluated his physical condition. Infants whose

Table 1. Optimal daily nutritional requirements in pregnancy and the optimal normal requirements of the average woman.[1]

Nutritional Essentials	Normal	Pregnancy[2] (4th Through 9th Month)
Calories[3]	2,200-2,400	2,600-2,800
Protein, Gm.	60	85-100
Calcium, Gm.	0.8	1.5
Phosphorus, Gm.	1.32	2.0
Iron, Mg.	15	20
Vitamin A,[4] I.U.	5,000	8,000
Thiamin, Mg.	1.5	2.0
Riboflavin, Mg.	2.0	2.5
Niacin, Mg.	15	18
Ascorbic acid, Mg.	70	100
Vitamin D, I.U.		400-800

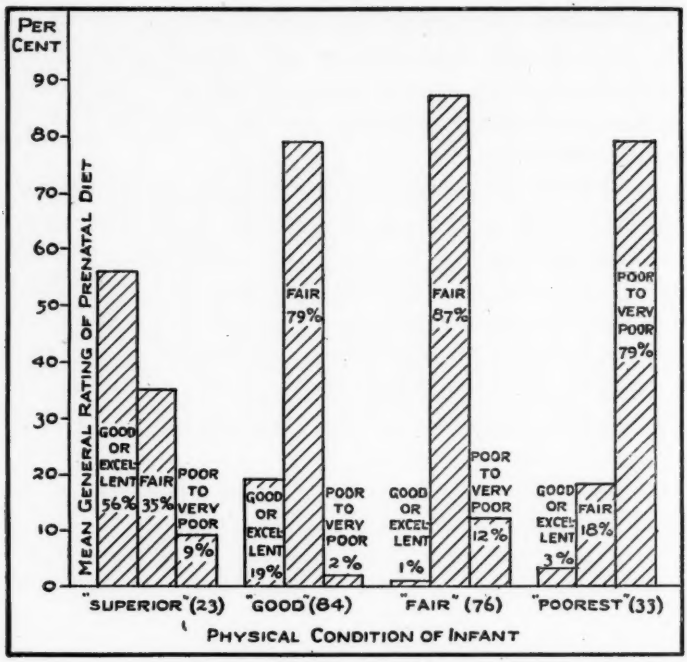
Courtesy of *American Journal of Obstetrics and Gynecology*. 46, July 1943.

[1] Generally accepted optimal nutritional requirements, according to available data.
[2] Assuming the changes in the first trimester to be so small as to be negligible.
[3] Energy requirements vary with activity, size of the individual, etc.
[4] The requirement for vitamin A may be less when provided as vitamin A and may be more if provided chiefly in the form of carotene.

neonatal course was unsatisfactory were seen frequently by the pediatrician, who also examined each infant again before discharge from the hospital. The pediatric ratings describing the condition of the infants at birth and within the first two weeks after birth are based upon these data.

Of the 216 women studied only 14 per cent consumed a diet which could be rated excellent or good according to these nutritional standards, 69 per cent had fair diets (23 per cent of these were fair to poor), and 17 per cent had diets which were poor to very poor. This means that approximately 40 per cent of these women were definitely malnourished according to these standards during a period when the fetus undergoes very rapid growth and development and that many more had only a mediocre diet during this very important growth period.

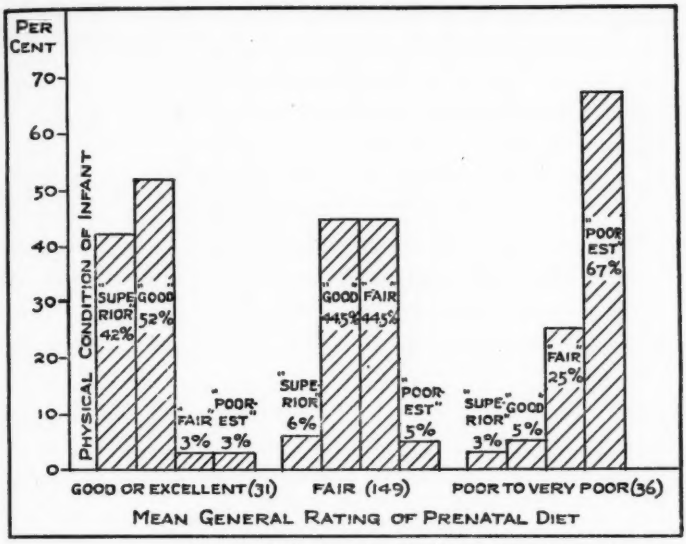
In considering the findings, you should remember that the ratings in each field, pediatric, obstetric, nutritional, anthropometric, etc., have been made independently on all mothers and their infants by the person in charge of the particular field, and the results assembled to determine possible associations of statistical significance. Considering the effect which prenatal nutrition may have on infant morbidity and mortality, the general dietary rating during pregnancy was studied in relation to the infant's condition at birth and within the first two weeks after birth. For ease of comparison those infants whose condition was called good or excellent and against whom there was no physical count of any kind at birth and during the first two weeks after birth were called "superior." There were twenty-three such infants (Figure 1). Fifty-six per cent of the mothers of these infants had a "good" or "excellent" diet during pregnancy, 35 per cent a "fair" diet, and only 9 per cent a "poor to very poor" diet. In contrast if the "poorest" infants, of whom there were thirty-three, are considered, i.e. those who were stillborn or who died within a few hours or days of birth, had a marked congenital malformation at birth, were premature or "functionally im-



Courtesy of *The Journal of Nutrition*, 26, No. 6, December, 1943.

Fig. 1. Relationship of the condition of infant at birth and within first two weeks of life to mother's diet during pregnancy. (Cases selected on the basis of pediatric ratings of infants, 216 cases.)

mature," it is found that 79 per cent of these prenatal diets were "poor to very poor," 18 per cent "fair," and only 3 per cent "good" or "excellent." Realizing that there were more "good" or "excellent" prenatal diets than infants who could be classified as "superior" and more "poor to very poor" diets than "poorest" infants, the cases were sorted on the basis of the mother's dietary rating for pregnancy (Figure 2). It was found that when the mother's diet was "good" or "excellent" (thirty-one cases) 42 per cent of the infants were "superior," and only one child (3 per cent) fell into the "poorest" classification because of a congenital defect; 55 per cent received

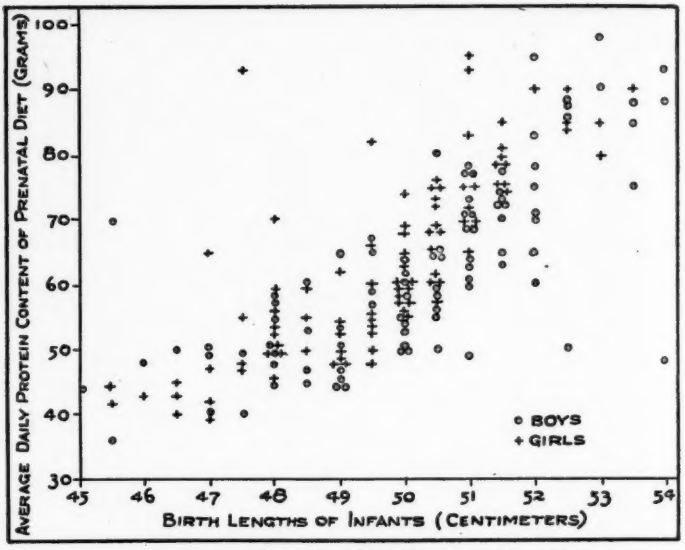


Courtesy of *The Journal of Nutrition*, 26, No. 6, December, 1943.

Fig. 2. Relationship of prenatal nutrition to the physical condition of the infant at birth and within first two weeks of life. (Cases selected on the basis of mean rating assigned to mothers' diets during pregnancy, 216 cases.)

pediatric ratings between these two extremes and the majority of these cases had only one, occasionally two, physical counts against them, largely minor in nature. In all cases where these physical counts were considered minor the infant was said to be in "good" physical condition. All infants who did not fall into one of these three carefully defined classifications were called "fair." In contrast, of the infants (thirty-six) whose mother's diets were "poor to very poor" only one infant (3 per cent) was "superior," while 67 per cent were in the "poorest" classification and 25 per cent were only "fair."

One hundred and sixty of the infants fell between the pediatric ratings "superior" and "poorest." Sorting these cases into the two now defined classifications of "good" and "fair" this middle group of 160 infants was divided into eighty-four "good" infants and



Courtesy of *The Journal of Pediatrics*, 23, No. 5, November, 1943.

Fig. 3.

seventy-six "fair" infants (Figure 1). In the case of the "good" infants 19 per cent of the prenatal diets were rated as "good" or "excellent," 79 per cent "fair," and 2 per cent "poor to very poor," while of the infants in "fair" physical condition only 1 per cent of the prenatal diets were "good" or "excellent," 87 per cent were "fair," and 12 per cent "poor to very poor." If the 149 "fair" diets serve as the basis of classification (Figure 2), it is found that 44.5 per cent of these infants were "good" and an equal number fall into the "fair" classification, only 6 per cent were "superior" and 5 per cent were classified as "poorest." The average birth weight of the "superior" infants was 8 pounds, 2 ounces and the birth length 50.8 cm., while in the case of the "poorest" infants the average birth weight was 5 pounds, 15 ounces and the length 47.2 cm. When selected on the basis of the prenatal dietary ratings the average birth weight of those infants whose mothers' diets were considered

"good" or "excellent" was 8 pounds, 8 ounces, length 51.8 cm., in contrast to 5 pounds, 13 ounces and 47.2 cm. in the case of those infants whose mothers' diets were "poor to very poor."

In analyzing the prenatal diets I was amazed at the number of women whose diets were poorly supplied with protein during this important growth period. Only 10 per cent of the 216 women had diets which could be considered "excellent" in protein (85 gms. or more per day), while 70 per cent consumed diets which were "fair" (55 to 69 gms.) or below in this important nutrient and 14 per cent ate less than 45 gms. daily. A significant relationship was found between the protein content of the mother's diet during pregnancy and the birth length of her infant (Figure 3). This increase in birth length can be demonstrated with each 10 gm. increment of protein in the mother's diet irrespective of the mother's height. An increase in birth weight was also demonstrated with each 10 gm. increment of protein in the prenatal diet (Table 2). The amount of protein in the diet during pregnancy seems to be a significant factor in the

Table 2. Relationship of birth weight[1] and birth length to total protein in mother's diet during pregnancy (fourth through ninth month).

	Average Total Protein (Gm.)					
	Under 45	45 to 54	55 to 64	65 to 74	75 to 84	85 or More
	Birth Weight in Pounds and Ounces					
Boys	6,8	7,0	7,7	8,0	8,5	9,2
Girls	5,14	6,14	7,8	7,12	8,1	8,8
	Birth Length in Centimeters					
Boys	47.6	49.3	50.2	51.4	52.0	53.3
Girls	46.8	48.7	49.9	50.3	51.4	52.4

Courtesy of *Journal of Pediatrics*, 23, November 1943.

[1] No infants under 5 pounds in weight were included in this distribution.

determination of an infant's birth length and birth weight. Since it has already been shown that these are related to the physical rating of the infant, the amount of protein in the mother's diet during pregnancy would appear to be an important factor in determining the general physical condition of the infant at birth (Table 3). From a practical standpoint these results indicate that less than 75 gms. of protein daily during the latter part of pregnancy result in an infant who will tend to be short, light in weight, and most likely to receive a low pediatric rating in other respects.

While a statistically significant relation was also found between the mother's dietary rating and the course of her pregnancy this relationship was not as marked as that existing between the prenatal dietary rating and the condition of the infant. Sixty-eight per cent of the women having a "good" or "excellent" diet during pregnancy

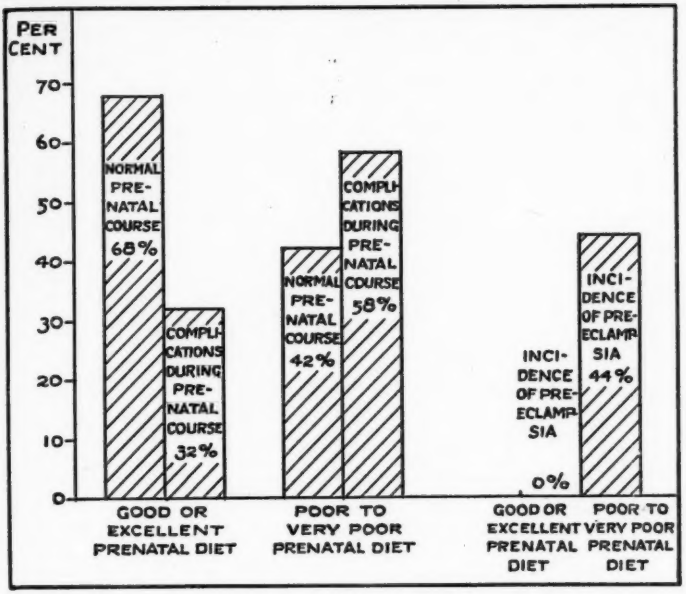
Table 3. Relation of birth lengths and birth weights to pediatric ratings assigned to infants at birth and within the first two weeks of life.

	Norm[1]	Pediatric Ratings[2]			
		"Superior"	"Good"	"Fair"	"Poorest"
	Mean weight in pounds and ounces				
Boys	7,10	8,6	8,0	7,4	6,11
Girls	7,8	7,15	7,12	7,1	6,15
	Mean length in centimeters				
Boys	50.6	51.5	51.1	49.9	49.1
Girls	50.1	50.8	50.2	49.2	49.4

Courtesy of *Journal of Pediatrics*, 23, November 1943.

[1] Vickers, V. S. and Stuart, H. C.: Journal of Pediatrics, 22, 1943, 155.

[2] The pediatric rating "superior" refers to all of the infants in the group of 216 against whom there was no physical count of any kind at birth, or within the first two weeks of life. "Good" includes all infants in the group who were considered in good condition, except for one or two minor physical counts. "Poorest" includes all infants who were stillborn, died within a few hours or days of life, had a marked congenital defect, were premature, or "functionally immature," except that in this table we have excluded those who were premature (weight under 5 pounds). All infants not in one of these three classifications have been termed "fair" (within this group are some infants who were in the "fair to good" range and others in the "fair to poor" range in physical condition).



Courtesy of *American Journal of Obstetrics and Gynecology*, 46, July, 1943.

Fig. 4. Relationship of the prenatal course to the mother's diet during pregnancy. Incidence of pre-eclampsia in relation to the mother's diet during pregnancy. Of the women (31) whose diets during pregnancy were "excellent" or "good," 21 had a normal prenatal course, 10 had complications, such as severe nausea (4), rheumatic heart disease (no failure, 1), marked anemia (1), severe epidermophytosis of hands (1), duodenal ulcer (1), edema (1), staining, (1). Of the women (36) whose diets during pregnancy were "poor to very poor" 15 had a normal prenatal course, 21 had complications as follows: pre-eclampsia (16), (9 had other complications as well); pernicious vomiting and severe anemia (1); marked anemia (3); and staining (1).

experienced a normal course, while only 42 per cent of the women with a "poor to very poor" diet had a normal pregnancy (Figure 4). This would indicate that with an inadequate prenatal diet the fetus may suffer to a greater degree than the mother. In other words the fetus is parasitic upon the mother only to a certain extent and that extent is limited apparently by the mother's nutritional state at the time she enters pregnancy and by the quality and quantity of her diet. It is very important to realize this fact, because in the usual

clinical examination during pregnancy it is not possible to evaluate adequately the condition of the fetus, and it is entirely possible that a woman may have an apparently normal clinical course, but if she is consuming an inadequate diet, the fetus will in all probability suffer. Contrary to the usual obstetric teaching, the health of the fetus is greatly dependent on the mother's nutrition during pregnancy. An interesting and highly significant relationship was found to exist between the mother's general dietary rating and the incidence of toxemia during pregnancy. While the incidence where the diets were rated "good" or "excellent" was zero, among the women whose diets were "poor to very poor" it was 44 per cent, and among those whose diets were "fair" 8 per cent (Figure 4).

Another interesting finding is that while the average hours of labor of all the primiparae whether their diets were rated "good" or "excellent" or "poor to very poor" were approximately the same (14 hours); those women whose diets were called "poor to very poor" experienced many more difficult types of delivery, all this in spite of the fact that the average birth weight of these infants was almost three pounds less than that of infants born to mothers whose diets during pregnancy were rated "good" or "excellent."

A study is at present being made of possible relationships between the woman's preconceptional weight, her weight gain during pregnancy, her weight at approximately two weeks postpartum, the infant's birth weight, and the mother's diet during pregnancy. While it is not possible to discuss these findings in detail at this time, it is apparent that our thinking in these respects has not been clear. Using Metropolitan Life Insurance figures as a basis for deciding a given individual's normal weight for height and age and calling +five pounds to -ten pounds of this weight "normal," 32 per cent of these women were found to be underweight against 24 per cent who were overweight when they entered pregnancy. In studying the weight gain during pregnancy in relationship to weight change (the difference between the preconceptional and the post-

partum weights) the underweight woman who gained during pregnancy approximately the same or more than the normal or overweight woman, gained more weight herself in relation to her preconceptional weight and gave birth to a smaller infant. The very overweight woman eating inadequate calories lost weight herself to a considerable degree but had a larger baby than the woman with adequate calories who was normal or underweight. Here again, apparently, is evidence that the fetus is parasitic upon the mother only to a degree and that we need to pay much more attention to the woman who enters pregnancy below ideal weight; if our figures are correct, she apparently needs to be allowed to gain in the neighborhood of twenty-four pounds above whatever is her ideal weight, otherwise "nature" will tend to protect her at the expense of her infant.

It would seem that we are justified in concluding that the prenatal period is an important period in life where effective and intelligent nutrition teaching would result in great gains to national health. It would be expected to result in lowered infant mortality and morbidity, especially in the neonatal period; it would bring about marked improvements in child health and development, and also in improved maternal health and mortality.

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THE IMPORTANCE OF PRENATAL DIET

JOSEF WARKANY, M.D.[1]

SEVERAL years ago Dr. Rose Nelson and I encountered a strange phenomenon. On a diet, the composition of which I will show you presently, anatomically normal female rats produced offspring one-third of which showed congenital malformations. The males, also anatomically normal, were fed an adequate stock diet.

The deficient diet, which we called Diet 1, consisted of yellow corn meal, wheat gluten, calcium carbonate, sodium chloride, the diet which you know as the Steenbock and Black diet. If you try to raise and breed rats on this diet you will encounter difficulties. The diet is deficient in many respects and so we added for certain reasons, viosterol to prevent rickets (Table 1).

On this diet we found that of 761 animals, 517 appeared anatomically normal and 244 (an average of 32 per cent) abnormal. Figure 1 shows some of these abnormalities. On the left is a normal newborn rat and on the right are three abnormals. These abnormals can usually be recognized by external inspection. You will notice short mandible, protruding tongue, shortness of the upper extremity, syndactylism of different degrees; then shortness of the lower extremity, and shortness of the lower extremity combined with clubfoot. The skeletal abnormalities can be seen much better if one clears the specimens with the Schultze-Dawson method.

In Figure 2 on the left, the skeleton of a normal newborn rat is seen, and on the right three abnormals. They show different degrees of abnormality. There is a pattern in this variety, in that certain bones are less affected than others. You will notice that the skull and the vertebral column are spared. The humerus and the femur are also usually spared, but the lower arm and the leg are affected.

[1] The Children's Hospital Research Foundation, Cincinnati, Ohio.

The defects of the ribs can also be seen. Some of these defects can be seen in detail in the three abnormals.

Note the normal chest and the regularity of the ribs in the normal newborn rat. In the first abnormal you may see just a slight approaching of two ribs. It is usually the middle ribs that are affected.

Table 1. Diet 1.

	Per Cent
Yellow Corn Meal	76
Wheat Gluten	20
Calcium Carbonate	3
Sodium Chloride	1
Vitamin D: 6 I.U. Daily as Viosterol	

The skeleton of the second abnormal newborn rat shows a further degree of fusion of ribs and in the third abnormal you see a complete fusion into a cartilaginous plate. By the way, the expression "fusion" is incorrect. One should say "nonseparation." We have studied such bones histologically and found that the ribs do not differentiate normally from the mesenchymal plate.

In Figure 3, there is a normal radius and a normal ulna, and in Figure 4A are slightly defective ones. You see that these two bones are shorter than normal. Figures 4B and 4C show further degrees of shortening, and Figure 4D, complete absence of the radius and ulna; a marked micromelia can be seen. If we speak of absence of a structure we mean the absence of bone. Cartilaginous structures may be present but they are defective too.

Figure 3 shows a normal tibia and fibula, and in Figure 4A a shortened tibia and a somewhat shortened fibula are shown. The tibia is more often abnormal than the fibula. Further degrees are shown in Figures 4B, C, and D.

Figure 5 shows various degrees of syndactylism. Figure 5A represents a normal hand of a newborn rat. In Figure 5B there is incomplete syndactylism of fingers III and IV and a slight separation is still visible. In Figure 5C there is complete syndactylism and in Figure 5D a marked form of syndactylism and brachydactylism.

I may add here that we have no control over the degree of these abnormalities. We may get normal and abnormal animals in one litter, and we may observe marked degrees of abnormality and milder abnormalities in the same litter.

Table 2. Frequency of osseous defects in 100 cleared abnormal specimens.

Tibia	93	Ulna	50
Mandible	80	Humerus	34
Ribs	75	Hindfoot	31
Fibula	63	Maxilla	8
Radius	58	Scapula	6
Hand	54	Clavicle	6
Sternum	52	Femur	1

Figure 6 shows on the left a normal palate of a newborn rat, and on the right a cleft palate. Interestingly enough, I think cleft palate was never described in the rat although it is described in many other animals. We never encountered a harelip in our specimens.

Figure 7 shows a mild degree of cleft palate, the so-called posterior palate cleft. Figure 8 represents a section through a head with a cleft palate in which you see a communication between the nasal cavity, the nasopharyngeal duct, and the mouth.

Table 2 lists the frequency of the various defects in 100 cleared abnormal specimens. The tibia is most often affected, shortness of the mandible follows, the ribs, fibula, radius, hand, sternum, ulna, palate, humerus, foot come next, and finally there are rarely affected bones like the scapula, clavicle, and femur.

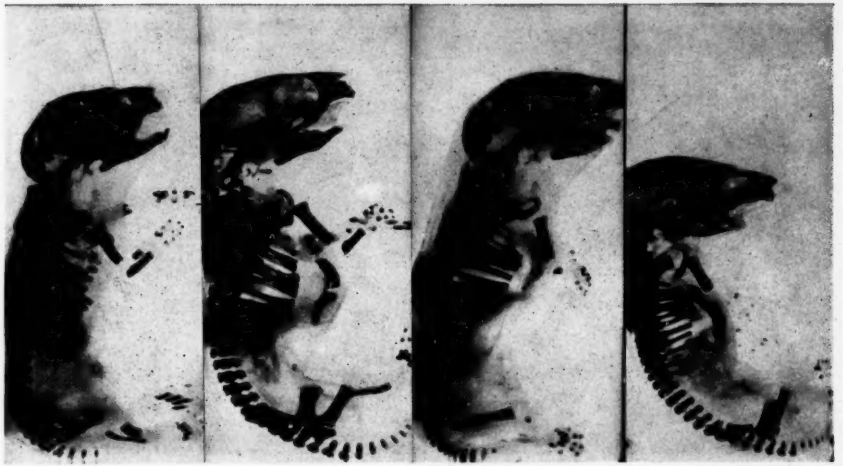
We did not take it for granted that we were dealing with a nutritional phenomenon. We know that the appearance of normal and abnormal animals in one and the same litter could be interpreted as a result of a genetic combination. It was thought possible that we were dealing with a genetic abnormality which just happened to show up in rats fed a deficient diet. Yet the following experiments are hardly compatible with any other explanation than the assumption of a maternal nutritional deficiency which manifests itself in abnormalities of the offspring.

On an adequate stock diet, parent rats of the same strain, the Sprague-Dawley strain, never produced abnormal young of the pat-

Fig. 1

Fig. 2

Fig. 3



A B C D

Fig. 4

Fig.

Fig.

Fig. 6

Fig. 7

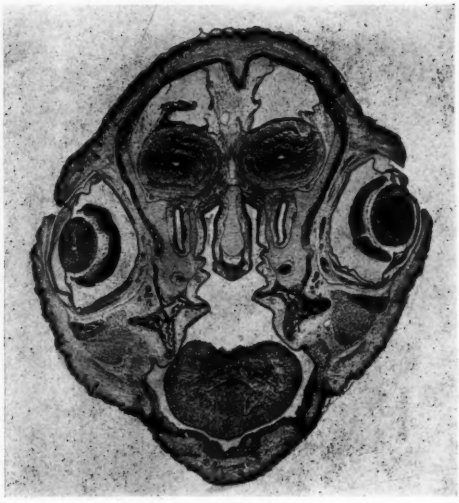


Fig. 8

Fig. 9

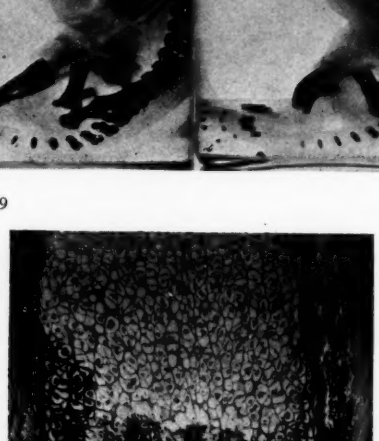


Fig. 10

tern of Diet 1. In 833 control rats we had 832 normals and only one abnormal. The one abnormal rat had a normal tibia and fibula and a short humerus and a short tail, a pattern which does not correspond to the pattern of Diet 1.

Very soon we found that the addition of 2 per cent of dried pig liver to Diet 1 prevented the abnormalities. We obtained on this diet 332 young; they were all normal.

The breeding results on alternating diets were as follows: Rat 45-B was raised on Diet 1 and bred and we obtained four abnormal rats. She was bred again on Diet 1, with the same result. Then liver was given and eight normals were obtained. If one adds liver to the diet of such rats, one obtains always normals. However, if one gives Diet 1 to a rat that had Diet 1 plus liver before, the first subsequent litter may be normal and it may be necessary to breed the rat again on the deficient diet before an abnormal litter is obtained. That can be explained easily by a storing of the factor in question, while the rat received liver. But this rat behaved very nicely. When she was put back on Diet 1 she produced one abnormal out of seven young; put back on liver, ten normals; and back on Diet 1, eight normals, and two abnormals; Diet 1, seven abnormals; changed back to Diet 1 and liver, three normals; after that she, unfortunately, died. This whole offspring was strictly legitimate and that is important, because the same male was used for all these matings.

I think no geneticist will be able to find a form of genetic transmission in which two normal rats can produce offspring in that way.

These experiments convinced us that we were dealing with a nutritional phenomenon. Diet 1 is obviously deficient in a factor which is present in large amounts in liver. The search for this factor was complicated by the fact that only one-third of the offspring of mothers on Diet 1 could be expected to be abnormal and that the first litters were less often abnormal than second and later litters. Therefore, a large number of normal offspring was necessary to prove that the supplement to Diet 1 was preventive, while it required only a

few abnormal young to eliminate a substance from the search.

Liver-ash added to Diet 1 did not prevent abnormality. There were twenty-one abnormals out of 163. The percentage given here should not induce us to draw conclusions because when we got a few abnormal litters frequently we stopped the experiment, since we knew that the substance tested was not preventive. Thus, liver-ash did not prevent; casein added to Diet 1 did not prevent; cod-liver oil did not prevent; wheat germ oil did not prevent. We tested a few other substances but it is not important to name them all.

We know that liver is a good source of the vitamin B complex, so we tried, together with Miss Elizabeth Schraffenberger, to ascertain the preventive power of some crystalline vitamins of the B complex.

A mixture of riboflavin, thiamine, niacin, pyridoxine, and pantothenate proved preventive. There were 371 young born of mothers on this supplemented diet, and they were all normal. It remained to be shown which of these five substances or which combination would prove preventive.

Thiamine, niacin, pyridoxine, and pantothenate together were not preventive. Then a pyridoxine-pantothenate mixture did not prevent. Thiamin alone and niacin alone did not prevent.

Riboflavin, on the other hand, prevented. We knew, therefore, that riboflavin was preventive, but we still were not quite sure if the rest of Diet 1 did not somehow contribute to the phenomenon. So we did the crucial experiment. We used a purified diet in which most of the food elements were of known chemical composition.

On a maternal diet of sucrose, casein, vegetable oil, salt mixture, vitamins A, D, E, K, thiamine, niacin, pyridoxine, pantothenate, and choline, the abnormalities were obtained when riboflavin was omitted. With riboflavin the abnormalities were prevented.

The abnormal offspring obtained from females on the riboflavin-free purified diet showed a pattern entirely identical with that of Diet 1, that is, shortness of the mandible, shortness of the arm, fusion of ribs, shortness of tibia, and cleft palate.

The abnormalities of the pattern of Diet 1 can thus be prevented by riboflavin. We have spent a great deal of time and effort to explain the pathogenesis of these skeletal defects. Time does not permit me to report these experiments today, but it may be mentioned that we assume at the present time that the rapid development from mesenchyme of the membranous skeleton, the forerunner of the cartilaginous and osseous skeleton, is inhibited by this nutritional deficiency.

Table 3. Diet R.

	Per Cent
Yellow Corn Meal	76
Wheat Gluten	18
Calcium Carbonate	3
Sodium Chloride	1
Dried Pig Liver	2

It is of interest that a very slight or quantitatively slight change of the maternal Diet 1 may induce congenital defects of an entirely different type.

Table 3 shows again the Steenbock and Black diet, but this time not supplemented by vitamin D but by dried pig liver. We had to give that supplement because on the Steenbock and Black diet the rats did not breed. When pig liver was added, they bred much better. We had even third and fourth litters on such a diet.

This diet is rachitogenic. The addition of dried pig liver does not change the rachitogenic qualities of the diet. If you put rats after weaning on this diet, they develop severe rickets.

We called this diet (the Steenbock and Black diet supplemented by dried pig liver) Diet R. On this Diet R, we had 136 normals and 112 abnormals, or 45 per cent, abnormalities. One cannot recognize these abnormalities on external inspection. The rats are usually born dead or they are in poor shape, but they appear anatomically normal. However, if you clear them with the Schultze-Dawson method, you can see the skeletal abnormalities.

In Figure 9 on the left, a normal rat can be seen and on the right you may see the bending of the tibia, of the fibula, of the ulna, and

of the radius. You can see a peculiar abnormality of the ribs; these ribs become suddenly broad and there is an angle in their bodies. The middle ribs chiefly are affected. There is never any overlapping of the two patterns of Diet 1 and of Diet R.

We thought we were dealing with congenital rickets. There is bending of the shaft and a definite cupping which might indicate that we are dealing with congenital rickets. But the situation is more complicated than we thought. You see in the abnormal tibia a mass of cartilage. The zone of cartilage is much deeper in the abnormal than in the normal bone, and there is a shortness of the osseous part.

The higher magnification in Figure 10 shows an interesting picture. There is marked cupping and a mass of cartilage, also blood vessels, but the histologic characteristic of rickets, the osteoid is missing; or the osteoid that is present is not abundant. We are confronted with an interesting fact: the vitamin D deficiency manifests itself in the fetus in a different way than in the infantile rat.

That a vitamin D deficiency is responsible for this condition can be deduced from the fact that only normal young were obtained when Diet R was supplemented by viosterol.

This brief outline of our experiments indicates that congenital malformations may be caused by maternal nutritional deficiency. The science of nutrition should be concerned, therefore, not only with the maintenance of the human machine but should also pay attention to its sound construction.

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PROTECTING THE HEALTH OF THE INDUSTRIAL WORKER: NUTRITION

ROBERT S. GOODHART, M.D.[1]

I WILL not take up your time with a discussion of the relation of nutrition to health. I assume that you are all acquainted with much of the literature on this subject and that there is general agreement that resistance to disease and fatigue are dependent, to a considerable extent, upon the body's nutritional status. The purpose of this talk is to review briefly the organization and accomplishments of the Government's industrial feeding program and to indicate the major problems which remain to be solved.

The Committee on the Nutrition of Industrial Workers, of the National Research Council, made the following six recommendations in its first report, published April 1942:

1. Nutritious meals of natural foods at prices the workers are accustomed to and can afford to pay should be made available in all plants engaged in production for war or defense purposes, except in small plants where the worker may obtain such meals from private sources in the free time at his disposal. Any meal served in the plant should contribute at least one-third of the daily requirements of specific nutrients recommended by the Food and Nutrition Board of the National Research Council.

2. The practice of serving food between meals to workers has given good results and is recommended. Milk, fruit, and tomato juices are to be preferred as beverages, and other foods which are served should include the necessary nutrients. Thus, when bread is served it should be enriched white bread or a whole grain product.

3. Choice of foods served in the plant should be determined by a trained dietitian or nutritionist. Brief study of workers' diets will enable the dietitian to make up menus calculated to compensate for the ordinary inadequacies. The employment of a dietitian or nutritionist by the plant is recommended.

[1] Surgeon (R) United States Public Health Service, Chief, Industrial Feeding Programs Division, Civilian Food Requirements Branch, Office of Distribution, War Food Administration.

4. Suitable educational material should be presented in connection with cafeteria service or supplementary lunches to stimulate acceptance of the meals planned or the selection of good meals when there is a choice of foods.

5. Measures should be taken by the appropriate subdivision of government to condition nutritionally those classes of the population which are likely to become workers in war or defense industries.

6. It is recommended that adequately controlled studies be conducted in selected war or defense industries to determine the facts concerning the influence of diet and nutrition on health, working capacity, incidence of accidents, absenteeism, and the psychological state (industrial unrest).

The Committee also emphasized, in its report, the following recommendations made by the National Nutrition Conference for Defense in May, 1941:

It is urgently recommended that special attention be paid to the diets and nutrition of all workers in industry and particularly of those most directly concerned with the national defense effort. The pressing importance of this problem should be drawn to the attention of the governmental agencies concerned with defense industries, such as the Office of Production Management.

It is recommended that the approval of contracts calling for construction or expansion of defense plants should include consideration of appropriate facilities for feeding the workers.

In view of the fact that in the emergency then existing, defense plants were being constructed in sparsely populated areas where normal community facilities are lacking, the Conference declared that:

In such instances communal feeding with its advantages of economy and expert supervision may be required and is recommended.

It is also recommended that the families of low-income workers in defense industries should be included in the distribution of protective surplus foods.

A direct result of these recommendations was the organization of a section on Industrial Nutrition within the Nutrition Division of the Office of Defense, Health and Welfare Service, in August 1942. In April 1943 the Nutrition Division was transferred to what

is now the Office of Distribution, War Food Administration. At present the Government's industrial feeding program is the immediate responsibility of the Industrial Feeding Programs Division of the Civilian Food Requirements Branch of that Office. The stated objectives of the program are to provide the food needed by industrial workers to maintain the highest efficiency in production; to improve and expand industrial food services to provide for workers in all plants where in-plant feeding is practicable; and to provide assistance and advice to obtain the best possible use of available foods.

Let us see what the accomplishment of these objectives involves, in Government organization alone. A number of Federal agencies, in addition to those acting as claimants for food for the armed services, lend-lease and for relief, directly or indirectly control in some measure the quantity, quality, variety, and cost of foods available for civilian consumption. The most important of these are the War Food Administration, the Office of Price Administration, the War Production Board, the Office of Defense Transportation, and the War Manpower Commission. The Federal Public Housing Authority and the Federal Works Agency, by means of their activities in defense housing, dormitories for war workers and community facilities in congested areas, influence the food consumption of thousands of war workers and their families. In addition the procurement agencies (Army, Navy, and Maritime Commission) through their control over funds and facilities in manufacturing establishments owned by them, and the authority they carry with prime contractors, must bear considerable responsibility for the amount and type of food service available to millions of workers. The Defense Plants Corporation, under certain conditions, has the authority to enter into contracts with plant management to finance industrial feeding facilities. There are other agencies, such as the Office of Community War Services and the President's Committee for War Congested Areas, which have a varying interest in the

adequacy of the nutrition of industrial workers. I mention these few to emphasize the fact that the Government's industrial feeding program is not and cannot be the sole responsibility of any one Federal agency.

Realizing this, the War Food Administration has consistently striven to develop understanding of the program among other Federal agencies, in addition to its efforts with management and labor, and has worked in cooperation with them. The various cooperative arrangements were formalized by the establishment of an Inter-Agency Committee on Food for Workers in October 1943. The first act of this Committee was to draw up a statement of "Agreement Regarding Objectives and Responsibilities," October 4, 1943. The following is an extract from this agreement:

The program includes:

A. Nutrition education conducted on a national scale as an integral part of the War Food program, enlisting the cooperation of all Federal agencies concerned, State and local government agencies and nutrition committees, labor, management, professional and trade groups, at all levels. Nutrition education should be conducted in all war plants. Nutrition education and in-plant food services operations should be integrated.

B. The establishment of food service standards to conserve food, equipment, and manpower.

C. Provision of rationed foods for workers on the basis of OPA ration allowances to individuals and to institutional users, unless such allowances are insufficient to meet physiological requirements because of nonavailability of nonrationed foods, increased need or any other circumstance making it impractical to meet requirements through an increased consumption of nonrationed foods. In such cases, supplementary allowances should be made on an institutional basis.

D. Maintenance of prices of prepared food at reasonable levels.

E. Provision of materials, equipment, and operating supplies needed for the feeding program. This involves the full use of second-hand and installed equipment.

F. Adjustment of manpower requirements for food services and for production of necessary materials, equipment, and operating supplies, stabilization of employment in and training of employees for restaurants and in-plant food services where necessary.

G. Such other steps as appear necessary.

Responsibilities of Federal Agencies

A. The Inter-Departmental Committee as a whole shall recommend and advise on over-all policies affecting development of the program.

B. The War Food Administration shall have the responsibility for coordinating the activities of Federal agencies relating to the industrial feeding program. It shall:

1. Conduct a comprehensive program of nutrition education.
2. Determine food needs to meet physiological requirements.
3. Determine food service standards.
4. Consult with OPA on food rationing and price problems.
5. Make recommendations regarding requirements for materials, equipment, and operating supplies. This shall be done with the assistance of the WPB, WMC, and the Maritime Commission.
6. Survey and make recommendations to war plants desiring assistance in the operation of industrial feeding programs.
7. Receive and review all applications, certifying them to WPB as to (a) need for the installations and (b) need for specific items for efficient operation.
8. Make recommendations to WMC regarding manpower requirements.

C. The War Production Board shall:

1. Prepare a materials, equipment, and operating supplies program, based on requirements submitted by WFA.
2. Act as claimant agency for the programmed requirements.
3. Take priorities action on application for materials, equipment, and operating supplies. No action shall be taken on any case until a recommendation has been received from WFA unless no recommendation is received after the lapse of a reasonable time for investigation and report.
4. Cooperate with WFA in devising methods for bringing into use second-hand and installed equipment not used to capacity.

5. Cooperate with WFA in the development of equipment based on recommended food service standards.

D. The Office of Price Administration shall:

1. Provide sufficient rationed food.
2. Be responsible for maintaining reasonable prices.
3. Determine the circumstances and methods under which supplemental food allowances shall be provided in accordance with the memorandum of understanding between the OPA and the Department of Agriculture, dated February 12, 1943.

E. The War Manpower Commission shall:

1. Determine manpower requirements receiving recommendations from WFA and WPB.
2. Be responsible for recruitment and training programs.
3. Take necessary steps to stabilize employment.

Subsequently, January 31, 1944, more detailed expressions of objectives and accepted responsibilities were received from the above mentioned agencies plus the United States Public Health Service, the War and Navy Departments, and the Maritime Commission. There is now no reason for doubt concerning the particular responsibilities of the various Federal agencies. A sound basis for an effective industrial feeding program has been established.

The War Food Administration has accepted the responsibility for program development and coordinating activities. It provides technical advisory service to labor and management, to other Federal agencies, and to state and local agencies and groups. In this function, it is assisted by the United States Public Health Service. It also serves as a "clearing house" for the handling of requests for assistance. It screens applications for facilities and brings trouble spots to the attention of the appropriate agency. Among Federal agencies, it has the prime responsibility for nutrition education programs, and it has the sole responsibility for the solution of food supply problems involving nonrationed items. The Procurement agencies, the Office of Labor Production of the War Production Board and the Committee for Congested Areas have varying responsibilities for seeing

that agreed upon recommendations actually reach the stage of implementation. Of course, the final responsibility for the success or failure of the program rests upon labor and management. Where these two groups are in agreement regarding what needs to be done and are equally desirous to see something done, there are generally few insurmountable obstacles.

The Office of Distribution of the War Food Administration operates through regional and district offices. Other Federal agencies have similar field offices. The cooperation established in Washington extends into the field, to a most encouraging degree. Inter-Agency Committees are established and functioning in all of the Office of Distribution Regions and in a number of smaller areas with a high concentration of war industries.

What has the Industrial Feeding Program accomplished, besides establishing this rather awe inspiring organization which I have outlined only in small part, limiting it, as I have, to Federal agencies?

Prior to Pearl Harbor, less than 20 per cent of the industrial workers had access to any type of in-plant food service. More exact figures are not available. Surveys made by the War Food Administration indicate that, by January 1944, about 30 per cent of the industrial workers were actually receiving meals through industrial feeding facilities (about 6.5 million of the 22 million engaged in war industries).

The number of plants having feeding facilities varies directly with the size of the plant. In the WFA surveys of industrial plants, only 27 per cent of the plants employing less than 250 had any type of feeding facilities, while 90 per cent of the plants employing over 2,500 had some type of feeding facility. The surveys also indicated that 49 per cent of all manufacturing establishments have food service facilities and that 79 per cent of the workers are employed in those establishments.[2]

[2] These data are based on surveys of manufacturing establishments which report employment information to the War Manpower Commission. During November 1943, 12,500 establishments employing 12.7 million workers reported.

In the San Francisco Bay area, however, it was found that not more than 15,000 meals a day were served to 176,000 shipyard workers. Less than 9 per cent of the workers are able to obtain any kind of food within the shipyards. Nevertheless, the number of war plants which are making efforts to provide food for their employees is steadily increasing.

We have estimated that an additional 5.5 million workers can be provided for during 1944. By January 1, 1945, in-plant feeding should be available to a total of 12 million. However, this goal will not be reached without sustained effort on the part of all the Federal agencies concerned with war production and the health of workers.

The establishment of new in-plant feeding facilities is not by any means the major task of the Industrial Feeding Program. At least 75 per cent of the time of the eighteen industrial feeding specialists now working out of the regional offices of the Office of Distribution is consumed in giving assistance on problems of operation, e.g. menu planning, food preparation and service, efficiency of operation, etc. The Industrial Feeding Programs Division of the Civilian Food Requirements Branch, Office of Distribution, has prepared material on meal planning and kitchen and food service facilities and organization which it recommends as standards for industrial feeding operations.

There has been considerable progress in the field of education. Of course, with educational programs, it is difficult to determine accurately what one has accomplished. One can, of course, record the contacts that one has made and the distribution of material. A nutrition news service reaches a large number of organizations and newspapers, the labor press and publications of one sort or another. During the past year the demands for material on nutrition by war plants for their own publications has increased from 800 to 6,000. Articles and feature stories are supplied regularly to 850 labor press editors throughout the country. Material is also provided to some 1,800 trade and business publications.

More than 125,000 copies of a Manual on Industrial Nutrition have been distributed. A manual on planning meals for industrial workers, containing menu suggestions for all varieties of industrial feeding setups has been prepared and more than 80,000 of these booklets have been distributed in response to requests.

There is in preparation a manual or recipe guide for mass feeding, primarily meant to instruct cafeteria managers on the utilization of meat alternates and meat extenders. There is available a pamphlet, entitled "Your Employees are No Better than the Food They Eat," directed toward management.

We have also prepared some material for nutrition programs within industrial plants. This consists of posters, table tents, and a "take home" pamphlet designed primarily to assist housewives who must pack lunches.

There has been some discussion as to whether or not this type of material, directed to the plant and designed to reach the worker in the plant, is effective in actually changing food habits. To answer this question, a study was conducted by the War Food Administration in several plants in two communities.

Very briefly, the survey shows that a well-run in-plant nutrition education program, integrated with the industrial feeding setup, can be very effective in changing eating habits. Sixty per cent of the industrial workers eating in the cafeteria in one plant manifested a change in food habits due to an educational campaign, closely tied in with the cafeteria operation. At the same time, within this group, there was a carry-over of the effect of nutrition education into the home, to the extent of 25 per cent of the group. I think that is very encouraging and indicates what can be done.

It must be admitted that nutrition education programs for workers and their families, both within and outside of plants, have not received the emphasis that the importance of poor dietary habits as a cause of nutritional deficiencies would seem to merit. There is not sufficient time to discuss the reasons for this, most of which are

based upon considerations of expediency and limitations upon personnel and budget.

The task of assuring workers the opportunity to eat adequately does not consist simply of providing in-plant feeding facilities. Access to proper food in the home and community is certainly at least as important. Aside from the 100 cafeterias in operation or under construction by the Federal Public Housing Authority in connection with their dormitories and the restaurant facilities provided with their housing developments, no governmental program for the provision of adequate community feeding facilities for workers in congested areas is in operation.

Obviously, a great deal remains to be done before any claims can be made that all reasonable effort is being expended to protect or improve the nutritional status of industrial workers. An itemized list of tasks requiring attention would include:

1. The devising and implementation of methods to provide adequate food for the some eight million industrial workers for whom in-plant feeding is not considered feasible.
2. The solution of problems arising from congestion and inadequate community and home facilities.
3. The training and employment of qualified dietitians, nutritionists, and managers for mass feeding services and industrial plants. One of the most pressing problems existing is the shortage of such qualified personnel.
4. The adoption of satisfactory food standards by food service operators.
5. Scientifically conducted on-the-job studies on the relation of nutrition and nutritional factors to the health and productivity of the worker.
6. Similar studies on the relation of nutritional status to toxic reaction in industry.
7. The development of effective techniques which can be applied by individual plants or local groups to get acceptance of basic nutritional facts by the workers, and the general application of such techniques.
8. Studies on the effect of food preparation and cooking practices, used in mass feeding operations, upon the nutritional value of the food

and practical recommendations on methods of protecting the worker from any loss of nutrients which results from such practices.

Although each of the above items represents a major task by itself, the most important and most urgent need remains to be stated. It is of prime importance that industrial management recognize the extent of its responsibility for the nutrition of its employees. I believe that this will result when the relationship between nutrition and health, morale, fatigue, industrial diseases, and accidents is clearly presented to management. This is a responsibility which should be assumed by the industrial physician, who should also take an active supervisory role in the industrial food service. Unfortunately, except in a few noteworthy instances, industrial physicians have been too preoccupied and overworked to take a very active interest in the workers' nutritional problems.

THE EFFECTS OF HARD PHYSICAL WORK UPON NUTRITIONAL REQUIREMENTS

W. H. Forbes[1]

BEFORE considering the nutrition of men doing hard physical work, it is essential to understand what constitutes hard work as the expression is used in this discussion. When a man walks up a 4 per cent grade at three miles per hour he produces about four times as much heat as he does in the basal state. The flow of oxygen and food to his tissues and CO_2 from his tissues must proceed at four times their usual rate to keep him in equilibrium. This increased flow of materials through him and his blood stream is easily maintained at this grade of work without disturbing the chemical equilibria of the blood to any extent. It is described as moderate work. If the grade is increased to 8 per cent, which doubles the work, these equilibria, particularly the acid-base balance, are measurably displaced as can be seen from an inspection of Henderson's nomographic descriptions of blood in rest (1), and in work of approximately this intensity (2). Even in this heavy work the changes in the blood though definite are small in comparison to those produced by disease (3, 4). However, if the work is again increased by raising the grade to 12 per cent, (an increase of 50 per cent in the work), it becomes exhausting; the ordinary man will be pushed near his limit and the equilibria of the blood will be shifted very considerably. If the work is further increased by raising the grade to 16 per cent, (only a 33 per cent change in the amount of work), it may be impossible for a man who is not an athlete to attain a steady state. The equilibria will be greatly and increasingly displaced and the work cannot be continued. In an athlete all these changes will occur at roughly 50 per cent higher levels of work, e.g. walking on the same grades at four and a half miles per hour instead of three. Thus the displacement of the equilibria of the blood,

[1] Harvard Fatigue Laboratory.

though related to the work done, is by no means proportional to it. At levels of work up to five times the basal value, the displacement is negligible; at seven or eight times it is small; at ten times, large; and at twelve times so great as to become intolerable to many. On the other hand the calories dissipated and the food required are directly proportional to the work done if allowance is made for the basal metabolism and if some minor variations in efficiency are neglected.

The primary need of a man who changes from a low level of work to a high one is for more calories. This has been known from antiquity and our knowledge has been put on an exact basis by the work of Atwater and Benedict (5) and many others (6, 7, 8). But even with all this work there has as yet been no comprehensive study of how fast the ability to perform hard work will disappear with different degrees of caloric deficiency. Christensen (9) has shown that a man who is fasting and working hard will deteriorate considerably in two days. Benedict and his co-workers (6) found surprisingly little change in men who were doing light work on a moderately low diet even after they had been on the diet four months. It seems not unlikely that in a given period of time as the caloric deficit is increased, either by reducing the food or by increasing the work, the disability may increase (like the disequilibria described above), at first less but finally more than in proportion to the deficit. A consequence and corollary of this is that a fasting man working hard, like Christensen's subjects, has a large caloric deficit per unit of time and may receive great benefit from being given a single meal containing even a small fraction of his daily requirements. A sedentary man on two-thirds of his requirements may not show a measurable improvement from receiving his whole requirements for the day.

Next in importance to the well-recognized and easily ascertainable caloric needs come the needs for special substances. Of these only the vitamins (especially the B group) and protein will be dis-

cussed here. It is convenient for discussion to consider three of the ways in which the requirements for such substances may behave as the work is increased. The requirements may be either (a) practically unaltered, or (b) increased in proportion to the work, or (c) increased in proportion to the displacement of the equilibria of the body, that is show little change until the work becomes really hard and then show a great increase.

The studies upon man give only clues as to which pattern is characteristic for which vitamin. There is a great need for work which is systematic enough to offer definite proof. There are two classes of observations which have a bearing on the vitamin requirements in heavy muscular work. One is upon the final effects of the deficiency, whether it appears to diminish the ability to work or not; and the other upon the influence of hard work on the rate at which the deficiency develops. The former class is primarily useful as a negative argument. If, as is the case with Vitamin A, the effects do not appear to have much connection with the muscles and even prolonged deficiencies do not impair physical efficiency (10) it seems probable, though not certain, that hard work does not increase the needs for this vitamin. It probably belongs to class (a) of the preceding paragraph.

With vitamin C on the other hand the effects of pronounced deficiency are to diminish greatly the ability to do work (11, 12, 13), but there is little in the records of explorers to show whether hard work brings on scurvy rapidly, though it is true that the necessity of doing hard work calls attention quickly to the disabilities of the condition. Experiments last summer in which both sedentary and working men were kept on scorbutic diets for eight weeks failed to show any difference between the groups (14). What little evidence there is does not suggest that for man muscular work per se increases the need for Vitamin C to any great extent. It is probably in class (a), possibly in class (b).

Vitamins D and K seem, like A, to be concerned with special

processes not closely related to physical work, and I believe there is no evidence as yet whether muscular work increases the requirements. The very absence of evidence in the face of the various peculiar and limited diets which are found in many parts of the world suggests that for adults deficiencies in these substances do not in practice limit the amount of physical work which can be done.

The relationship of the various muscular dystrophies found in ducks and rodents on E deficient diets to muscular weakness in man is unknown. The condition appears to be rare, but if it occurred work might well aggravate it, judging from experiments on animals.

The situation with vitamin B is different. Most observers have found that on diets deficient in the whole complex men first lose their willingness and then their ability to work. Weakness is among the symptoms of deficiency and there is evidence that hard work greatly hastens the onset of the symptoms (15, 16, 17, 18). The cases of acute beri-beri seen in China frequently follow a bout of hard work and a large carbohydrate meal (19). On the other hand Keys (20) in the most careful study so far reported has found no effects from a B deficient diet continued for a matter of weeks, even when the men worked hard. The discrepancy between his results and those mentioned above is not easy to explain, but in my opinion an explanation is possible by assuming that the requirements for this complex follow the general pattern of class (c) described above. Though the evidence is not unequivocal, it seems from the descriptions of the experiments that Dr. Key's subjects, though doing a great deal of work, were well trained for it, and that this work did not constitute as great a strain for them as the work given to the subjects both trained and untrained used by the other workers. If, as in the description given above of different grades of work, it is not the absolute amount a man does but how near he gets to his own individual limit which determines the disturbance in his homeostasis; and if further the requirements of the B complex are related

to this disturbance, then many of the conflicting observations can be harmonized. Really exhausting work which may be accompanied by muscle soreness and the breakdown of a little muscular tissue and from which a man scarcely recovers before the next day may require large amounts of certain members of the B complex, while work which is hard but not exhausting may not. Work which is so exhausting as to be "unphysiological" offers a tempting analogy to various pathological conditions (including hyperthyroidism) which are reported to result in increased requirements for the B group.

Very little is known about the needs for the various members of the B complex. Johnson's work, (16) though it was a preliminary study and incomplete, indicated that thiamin is by no means the only members of the complex which men working hard must have to stave off deterioration. Riboflavin, however, did not prevent deterioration (16) nor will deficiency in this factor interfere with physical performance (21).

Recent papers (22, 23) seem to confirm again the earlier experiments of Chittenden (24) and others in showing that the need for protein is not increased by muscular activity in spite of the popular idea that athletes, loggers, etc. must have meat in quantity. The period in these recent studies was only eight weeks, the protein not very low, and the work only moderately hard, but there were no indications at all of greater needs in the working group. The question of storage complicates the picture here as it does with all short-term experiments upon diet, but it seems fair to say that the trend of recent work has been to support the view that work does not increase demonstrably the protein requirements, but the possibility remains that long continued very heavy work may do so.

Water and salt should be mentioned because under ordinary conditions the requirements of the former particularly are increased by work. It is not the work per se but the extra heat that accompanies it which calls for extra water. Under most modern conditions

our clothes and buildings are adjusted to be comfortable for the man who is sedentary or doing very light work. A man at four or more times his basal rate of metabolism will be hot and sweating. Recent work (25) indicates that water, even in excess of quenching thirst, is beneficial and that the importance of salt has been over emphasized. Salt is necessary when sweating is heavy, but part of its benefit is due to the extra water which is taken with it.

The question now arises what proportion of the population does hard work as it is defined here. The answer is that the proportion is small. For 10 to 20 cents one can purchase electrical current which will provide as many horsepower hours as a strong man can deliver in a week, consequently in industry heavy work is done by motors. Farmers do moderate work, loggers and a few other trades hard work (26), soldiers on occasion hard or even exhausting work, though this is avoided by intelligent commanders, except during training. Nothing is known of the extra requirements, if any, for the kind of work that the average industrial worker performs, namely, work which is physically easy but nervously or emotionally tiring.

This survey may be summarized by saying that though definite proof on most points is lacking the indications are that light or moderate or even hard physical work adds primarily to the caloric requirements and increases the needs for protein and vitamins A, D, C, and K little if at all. The need for the B complex may be increased somewhat but probably less than in proportion to the extra calories until the work becomes hard or exhausting, when it almost certainly rises considerably. Nothing is known about E deficiency in man, but judging from animals the requirements may well rise in work. In view of the foregoing it seems possible that a man on a diet limited in quality but not in quantity, if on the borderline of deficiency, might make his nutritional status better rather than worse by doing moderate work because of the larger quantity of food he will consume.

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THE IMPROVEMENT IN NUTRITION AS PROTECTION AGAINST INDUSTRIAL TOXICITY

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THE subject of the increase or decrease of industrial poisonings as related to nutritional deficiency in industry is a field that has been, shall we say, neglected. It is a very fertile field for investigation and one which in the future is likely to achieve a status of vast importance.

Obviously, in any program dealing with this subject, protection of the worker, two methods of approach are essential. The first is the suitable installation of ventilation for removing such materials as dust, fumes, and vapors. This is generally accomplished by safety departments, and today a rather remarkable job has been done, considering the tremendously increased number of individuals exposed to various toxic substances. Acute cases of poisoning in industry are relatively rare. When they do occur, it is generally a function of carelessness on the part of the operator himself, oversight on the part of the supervisor or some person of like authority, or in times like these when we are subject to conditions which are not normal, a combination of these circumstances may be responsible for accidental exposure of personnel to dangerous substances.

The recent incident that occurred in a Kentucky parachute plant where 137 workers suddenly evidenced a rather marked and acute response to carbon tetrachloride may be cited. It was discovered that open bowls of the material had been left standing on the work tables for the purpose of cleaning machine oil from the nylon materials from which the chutes were made. Because of the fuel shortage and necessary conservation of heat, ventilation was reduced; the result was obvious and dramatic. One hundred and thirty-seven workers presented gastrointestinal complaints. As soon as the cause was determined, the solvent was immediately changed to a more innocuous one, notably warm water and soap.

[1] Merck & Company, Inc., Rahway, New Jersey.

Aside from such infrequent occurrence, however, the majority of industrial poisoning cases are of the chronic type and only a certain portion of employees are affected. It is in this group, wherein susceptibility plays such an important role, that the field of investigation should now be concentrated.

Human experience and animal experimentation have established the fact that susceptibility to any toxic substance varies tremendously between the species and even in given members of the same species. This variation is rather the rule and not the exception.

It has also been demonstrated that man, in general, is more susceptible to almost any toxic substance than any given type of animal. Public health studies in various occupations by industrial physicians and other industrial personnel indicate that individual resistance to poisoning varies quite widely, with age, sex, physical type, and, of course, general health. Perhaps if there is such a thing, the one common denominator is the nutritional status of the employee.

The importance of adequate and well-balanced nutrition on maximum work production, mental and physical alertness, nervous equilibrium, and general well-being, is becoming recognized, but it is only lately that it has become prominent. Its bearing on resistance to toxic environment has not yet been sufficiently investigated and certain deductions must be made largely by analogy. For example, it is well known that general undernourishment or a deficiency of some vital element of nutrition increases fatigue, and it certainly increases the susceptibility to infection. I do not feel that it is a long jump from this demonstrated fact to the assumption that such nutritional deficiencies increase susceptibility to toxic exposures.

This deduction has a certain amount of scientific background in animal experimentation and certain empirical evidence has been found in human beings. In many instances some particular element of nutrition has been shown to have a specific effect on the action of toxic substances, either increasing or decreasing their action within the body. This is exemplified by the various experiments, the

results of which you have seen, dealing with the addition of casein and riboflavin to the diets of rats. I have in mind a very dramatic experiment wherein the addition of these elements to the diet had a profound protective effect against the carcinogenic action of certain of the dye products, the dimethylaminoazobenzene and other nitro compounds, which have produced, experimentally, tumors of the liver.

High-fat diets in vitamin C deficiency are known to lower the efficiency of the liver too, and to render individuals suffering from such a complaint much more susceptible to such poisons as trinitrotoluene, which seem to have a specific effect on the liver. Certain other poisonous substances which are encountered in industry, notably benzol, a widely used compound, act more or less on the blood by destroying the red cells, and the effects are very dangerously increased in individuals who show some evidence of anemia, this certainly is a function of nutrition in many instances.

Diets low in protein, and a lack of iron, generally speaking, are essentially inadequate in maintaining the normal blood constituents. It is particularly important in those individuals who in industry are being depended on to do a specific job and do it well.

Although the study of diet with relation to industrial poisoning is certainly in its infancy, there are a number of reports in the literature which show the effective use of food, both experimentally and clinically, in the prophylaxis as well as the treatment of poisoning.

More than a decade ago, Lamson (1) and his co-workers found that dogs fed on normal diets tolerated well very large doses of carbon tetrachloride. When the calcium content was reduced by withholding bones from the diet, the dogs developed in a relatively short time tetanic convulsions, gastrointestinal distress, hemorrhages, vomiting, retention of urine. Upon restoration of bones or calcium in some other form to the diet, these symptoms disappeared, and carbon tetrachloride in the previously administered dosage was tolerated quite well by these animals.

Similar symptoms, unquestionably, develop in humans. Consequently, the dietary regime for industrial persons who might be exposed to compounds such as carbon tetrachloride by inhalation of the fumes should have their diet rather well supervised.

In the Kentucky incident that I mentioned a moment ago, blood serum estimations on sixteen of the patients with symptoms of poisoning showed that in 50 per cent, or eight of these individuals, the serum calcium was well below the normal. The attending physicians recommended that the persons unavoidably exposed to such a compound be given a quart of milk a day in addition to their regular diet to increase their blood calcium level. They were also asked to avoid greasy foods, oily laxatives, and particularly to avoid alcohol, which apparently increases the toxicity of carbon tetrachloride and such substances.

Calcium is also a very important factor in poisoning from hydrofluoric acid. This substance is encountered in various industries, such as bleaching, dyeing, brewing, the manufacture of insecticides, and in the finishing of decorative glass. When hydrofluoric acid vapor, or fluorine gas, is inhaled, it acts more or less as a protoplasmic poison and also interferes with the normal metabolism of calcium. The most common clinical symptom resulting from calcium deficiency is, again, tetany; death has resulted from massive exposures. Chronic symptoms are loss of appetite, anemia, eczema, conjunctivitis, muscular cramps, and in individuals and animals exposed to moderate quantities over long periods of time, a change in skeletal structure resembling a type of osteosclerosis or exostosis.

In this country to date, we have had no outstanding examples of fluorine exposure and subsequent exostosis, but in cattle that have grazed continually through a good portion of their life span in the vicinity of a foundry where the flux used contained a large amount of cryolite, x-ray examination revealed a porous structure of the mandible. This was due to the amount of the material ingested with their grazing food.

Treatment of this type of poisoning or prophylaxis where exposure is inevitable, certainly should include the dietary intake of extra calcium in the form of milk or calcium lactate by mouth. Dietary calcium also plays a rather important role in lead poisoning. Lead enters the system chiefly by way of nose and throat, by inhalation, where it is absorbed from the lung in the circulating blood. It has an injurious effect on the capillaries, red blood cells, and nerve tissue. Eventually much of this circulating lead becomes stored in the long bones in the form of tertiary lead phosphate, where it does relatively little damage. The remainder is excreted by the kidneys. The storage and excretion of lead appear to be controlled by the calcium metabolism. If the patient's diet has a high calcium content, lead is deposited in the bones, immobilized, so to speak.

In cases where some systemic change causes a demobilization of lead and its return to the circulating blood, acute poisoning symptoms appear. Some things which might effect the mobilization of lead are administration of thyroid extract, low calcium diet, acute infection, or anything having a tendency to promote acidosis.

In the treatment of acute lead poisoning the administration of calcium intravenously and orally is essential and chronic cases should be placed on a diet rich in calcium and given about sixty grains of calcium lactate daily by mouth. Nutritional prophylactic treatment for workers exposed to lead, even at its irreducible minimum concentration, is essentially the same as that for preventing rickets; that is, a quart of milk daily, a tablespoonful of cod liver oil or vitamin D in some other form. This regimen is usually sufficient to maintain a calcium balance that is definitely positive and reduces the appearance of this condition markedly. Milk, as a matter of fact, I think can be used most efficaciously in any industry wherein heavy metals are extensively employed and where small particles of these heavy metals might be accidentally deposited in the nose and throat and subsequently swallowed.

Investigators have advocated the administration of vitamin C in

lead poisoning. Now it is true that vitamin C inactivates lead more or less by formation of an ionizable lead ascorbate salt or complex of such a salt in the test tube. Unfortunately, extensive controlled clinical experiments do not bear this out.

Nickel poisoning is an entity which is being seen now a little more than previously because of the wider use of nickel carbonyl, which is sufficiently volatile to be inhaled. Nickel poisoning causes degeneration of the heart, the liver, the kidneys and treatment includes forced elimination through the bowels and kidneys, and placing the patient on a low-fat diet. Although no reference has been found in the literature on the prophylactic use of a low-fat diet in workers exposed to nickel, such a procedure seems to be indicated and is one which might be used very effectively.

Benzol and its compounds are very important sources of poisoning. Their fat-solvent properties permit a very rapid penetration into the blood stream and subsequent concentration in the bone marrow and the brain, with destruction of the red cells, of course, in the bone marrow where they are manufactured.

The blood picture in the early stages of benzol poisoning shows anemia, leukopenia, thrombopenia, and diminished clot retraction. Clinical symptoms include nausea, vomiting, headache, dizziness, weakness, and hemorrhages from the mucous membranes, or into the skin in the form of purpura. Women appear to be much more susceptible than men and, if pregnant, exposure to benzol tends to promote abortion. According to Seyfried (2), nutritional deficiencies, especially in vitamin C and riboflavin, and obesity, cause greater susceptibility to the aromatic hydrocarbons. Administration of vitamin C is said to correct the hemorrhagic tendency. Moreover, experiments on guinea pigs conducted by Demole (3), of Basle, have shown that chronic benzol poisoning inhibits the normal storage of vitamin C in the adrenal glands and the liver and increases the vitamin C requirement. Meyer (4) has observed a deficiency of vitamin C approaching scorbutic levels in human cases

of benzol poisoning. Hence, a greatly increased dietary intake of ascorbic acid by exposed workers might be useful as a prophylactic measure. Other nutritional factors which have been found beneficial are liver, iron, calcium, lactoflavin in the form of whole milk, and yeast.

Among workers in nitrobenzol and other nitro compounds of the benzol homologues, poisoning results from inhalation of the vapors and absorption of these compounds through the skin. These chemicals act chiefly by causing a type of decomposition of the red blood cells and formation of methemoglobin which produces a secondary anemia similar to that seen in carbon monoxide poisoning, or intoxication. Exposed workers should by all means avoid fats, milk, and especially alcohol, all of which increase the absorption of the toxin into the tissues.

Poisoning by TNT, popularly manufactured in practically every section, constitutes a very large hazard and appears to be influenced somewhat by diet. Experiments with rats have shown that severe symptoms and pathologic lesions result from this substance when the animals are given a ration high in fat, whereas the effect of the exposure to TNT was decreased by very high carbohydrate rations and was found to be almost nil in high protein diets. A reduction of hemoglobin in the blood and fatty infiltration and necrosis of the liver are among the severe effects produced on a diet with a high fat content.

The effects of trinitrotoluene poisoning are very similar to this in man. This is borne out by an examination of Finnish munition workers, reported by Noro (5) who showed that the blood levels of vitamin C in about half of the cases of TNT poisoning were notably low. He recommended a treatment which included a high-carbohydrate, low-fat diet, with additional protein and vitamin C and B complex.

In 1942, Dr. Foulger (6) studied the prophylactic effect of administration of 100 mg. of vitamin C daily to workers exposed to

TNT. He found indications of a beneficial effect of this type of treatment.

The much higher incidence of this form of poisoning reported among munition workers in England may be due in part to the notoriously poor diet of the English working man since the outbreak of the war. British investigators have suggested the use of a diet augmented with protein as a prophylactic measure in workmen under this exposure, but no reports as to the effect of this type of regime have as yet become available.

There is a certain relationship between exposure to carbon bisulfide and vitamin B_1. It has been demonstrated by Lewey, who found a remarkably diminished urinary excretion of thiamine in viscose rayon workers who were chronically exposed to carbon bisulfide vapor. Chronic poisoning may affect all parts of the nervous system, both central and peripheral. These effects may be due to thiamine deficiency resulting from liver damage and also to direct poisoning of the coenzymes of nerve metabolism and of respiration.

At any event, treatment with massive doses of vitamin B_1 rapidly improved the peripheral nervous symptoms and Lewey recommends meals very rich in vitamin B be provided by cafeterias of plants using carbon bisulfide, and the same advice might well be extended to plants using other industrial solvents, almost all of which have a damaging effect on the central nervous system.

Another compound, tetrachlorethane, an organic solvent used almost universally, and particularly in connection with war production, is responsible for a large amount of the industrial toxicity that is seen. Inhalation of its vapors and absorption through the skin may cause severe symptoms and one fatal case has been reported as a result of direct contact with the substance. The predominating symptoms may be related either to the nervous system or to the gastrointestinal tract. Common manifestations of the nervous form are abnormal perspiration, twitching of the facial muscles, disturbances of the motor and sensory reflexes, particularly in the

extremities. The chief effects on the gastrointestinal tract are anorexia, vomiting, nausea, jaundice, a hemorrhagic tendency, and in some cases the appearance of acites. In six nonfatal cases reported by Coyer (7) in 1944, treatment included the administration of vitamin K, injections of liver extract and glucose, and a high carbohydrate diet. Alkaline drinks and fruit juices were given freely. The treatment seemed to be very efficacious.

Wilson and Brumley (8) observed twenty-five cases of intoxication in varying degrees, among 1,000 persons exposed to tetrachlorethane. The substance appeared to act directly on the liver rather than on the blood cells, and the icterus index is now believed to be the earliest method of detecting this type of intoxication. Persons in the older age groups, obese individuals, and the colored were found to be especially susceptible to this form of poisoning. A high-fat diet appeared to be a very prominent factor in susceptibility. The authors recommended the distribution to exposed workers of printed diet instruction lists, recommending a reduction of fat consumption with an increase of carbohydrates, proteins, and vitamins, and the avoidance in all instances of alcohol. The cases reported were treated with intravenous glucose, liver, and iron for the anemia, and multiple vitamin capsules, and they did well.

Selenium is a compound which is beginning to come to the front now as an offender. It has been rather widely studied in South Dakota, where this substance is present in the soil and consequently present in substances grown in the soil in such abundance as to render it toxic to animals and to some extent to human beings. Selenium poisoning may constitute an industrial risk in the refining of copper, lead, zinc, in which the substance is often present, and also in the roasting of pyrites, and the making of lime and cement. Compounds of selenium are used in the manufacture of glass and ceramics, vulcanization of rubber, and various other processes. The substance is also an essential element in the making of the photoelectric cell.

Selenium poisoning has been investigated chiefly in animals. The most constant symptom is a progressive anemia with degenerative changes in the liver. Feeding experiments in rats have been made to determine the relationship of diet to the severity of symptoms. Vitamins A, D, and the B complex were found to have no beneficial effect; crystalline vitamin B_1, as a matter of fact, greatly intensified the symptoms in every case. Cystine, likewise, proved to be ineffective. Rations containing a high protein content have produced the best prophylactic results. From various reports, it would appear that the proteins of casein are the most beneficial. It has lately become apparent that the addition of the amino acid, methionine, to a diet low in calcium has an equally favorable effect and is one that should be borne in mind.

It has been pointed out by Reed and Harcourt (9) that most of the soluble selenium compounds are capable of producing acute and chronic symptoms in man, either through inhalation, skin absorption, or by way of the gastrointestinal tract. Whatever may be the mode of entry, they give rise to gastrointestinal symptoms, irritation of the nose and throat, and a metallic taste. The diagnosis of selenium poisoning in all instances may be confirmed by the finding of this compound in the urine. A high-protein diet is urgently recommended in the treatment, and while, again, I have seen no reports of its use as a prophylactic among the industrial personnel, such a diet, preferably rich in casein, certainly appears to be indicated.

Rösing (10) has reported the beneficial effects of a general improvement in nutrition among arc welders in Germany. After a study of the high incidence of gastrointestinal disorders at the Krupp Works, he concluded that the causative factor was the inhalation of metallic fumes in the process of welding, an entity which we are becoming acquainted with in this country. Such exposures in confined spaces, when the workers refuse to wear protective masks, give rise to the symptom complex of acute gastric pain, nausea, and vomiting known as "fume fever."

In the prophylaxis of this condition, the importance of a good diet is stressed. Warmed-up food, poor in vitamins, cold drinks, the excessive use of tobacco and alcohol, all contribute and were considered as one of the prime conditioning factors. In some industries, welders have been given soup, gruel, or milk, during working hours, with excellent results.

The need for improvement of diet among industrial workers as a whole has been demonstrated sufficiently in numerous surveys and studies, both by groups and individuals, and I have particular reference to the work done by Dr. Borsook, Dr. Alpert, and Dr. Keighley (11) among the aircraft workers in Southern California, and by Dr. Goodhart, who has done so much work among the industrial personnel in the East. With such data as we have in mind from these sources, it is hoped that further attention may be directed toward the nutritional needs of employees in those industries which present such specific and special hazards. I think that it is fairly obvious that certain of these conditions may be greatly ameliorated by protective diets, designed in accordance with specific needs for these compounds. It is becoming very increasingly apparent that the approach and solution to this problem can only be done through groups, or a group such as your own, and industry has become dependent on you.

Too many of the larger industries in this country are not sufficiently aware of the hazards or are not willing to allocate funds to maintain a laboratory or department with facilities for studying the nutritional status of the personnel. Therefore, it obtains that this, at the moment, is about the most fertile field that I can think of for scientific research, particularly with a view to mass improvement of a vital and necessary sort.

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